RUSSIAN MARITIME REGISTER OF SHIPPING

RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF INLAND NAVIGATION SHIPS

(for European Inland Waterways)

ND No. 2-020101-059-E

Saint-Petersburg
2010

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LIST OF CIRCULAR LETTERS AMENDING/SUPPLEMENTING NORMATIVE DOCUMENT

ND No. 2-020101-059-E

Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways) (2010)

(Normative document No. and title)

Item No.	Circular letter No., date of approval	List of amended and supplemented paras
1.	002-4.1-458ц dated 11.02.10	Part I: 2.1.4, 3.4.1.
2.	010-2.ГрМ-460ц dated 12.02.10	Part IV: paras 4.1.3, 4.3.2, 4.3.3, 4.3.4.
3.	007-2.2-463ц dated 11.03.10	Part III: 1.2.5, 2.1.1, 2.9.8 - 2.9.10, 3.1.16, 3.2.1, 3.2.1.1 - 3.2.1.6, 3.2.2.1 - 3.2.2.3, 3.2.2.5.1, 3.2.2.6, 10.3.7, 10.4.2.5, 10.4.6. Part VI: 2.1.1, 2.1.2. Part VII: 5.1.7, 11.1.9, 11.1.10. Part IX: 19.1.3.1.1. Part XI: 3.4.6. Part XIII: 2.7.2.1, 3.4.1, 6.2.1, 6.3.5, 6.3.6, 6.3.8, 6.3.10.
4.	007-2.2-507ц dated 29.12.10	Part I: 1.1.2, 1.2.3.4, 1.2.3.5, 2.2.8, 2.5.2. Part II: 3.1.1.1, 3.1.2.1.2, 3.1.2.2.1, 3.1.2.2.7, 3.1.2.2.9 - 3.1.2.2.11, 3.1.2.3 - 3.1.2.5, 3.7.2, 3.7.5, Appendix. Part III: 2.1.1, 2.4.10, 2.9.1, 2.9.10, 5.4.1.2, 5.4.2, 5.4.2.1, 5.4.2.1.1 - 5.4.2.1.3, 5.4.2.4 - 5.4.2.6, 5.4.3.1, 8.8, 9.2.7, 9.4.5 - 9.4.12, 9.5.10, 10.11. Part IV: 3.10, 3.10.2 - 3.10.6. Part V: 3.3.1.1, 3.3.1.5, 3.3.6.6.9, 4.2.9, 4.2.11, 4.5.1 - 4.5.3, 4.5.5, 4.5.27.5, 4.6.2.2, 4.6.2.6, 4.6.6.1, 4.7.1.1 - 4.7.1.4, 4.7.5, 4.7.6, 4.7.7, 5.7, 5.10, 5.11, 5.15. Part VI: 2.1.1, 2.1.3, 2.5.2, Appendixes 1 and 2, 3.2.9, 4.1.3. Part VII: 6.11.8, 6.11.9, 7.4, 9.2.5, 10.1.13, 12.7.1, 12.8.7, 19.1.1. Part VIII: 2.1.4, 2.1.5, 6.1.8. Part IX: 6.3, 6.3.7 - 6.3.11, 6.6.1, 7.4, 7.6, 7.7, 19.1.3.1.2, 19.1.3.4.1. Part X: 2.6.1, 2.7.4, table 2.11.9. Part XIII: 2.1.1, 2.2.1.6, 2.2.1.7, 2.3.2.5.1, 2.3.2.5.4, 2.7.2.1, 2.12.2.1, 2.12.2.2, 2.12.2.4, 2.12.2.6, 3.2.1.2, 3.5.2, 4.3.1.1, 4.3.4.1, 5.1.2, 6.2.1, 6.6.1.

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Item No.	Circular letter No., date of approval	List of amended and supplemented paras
4.	007-2.2-507ц dated 29.12.10	Part XIV: 1.2.1, 2.3.10, 2.3.11, 2.4.1, 2.4.2, 2.4.3.

Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways) of Russian Maritime Register of Shipping have been approved in accordance with the established approval procedure. The date of coming into force of the present Rules is 1 January 2010.

The present edition of the Rules is based on Rules for the Classification and Construction of Inland Navigation Ships (for the Danube), edition 2001, Notice of amendments thereto, edition 2007, containing requirements for inland navigation ships carrying dangerous goods by European inland waterways, as well as amendments developed immediately before publication considering the provisions of the Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006 establishing technical requirements for inland navigation ships operating on European inland waterways, as well as the provisions of the Resolution No.61 of the UN Economic Commission for Europe "Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels" which are applicable for the classification purposes.

The requirements of the Rules fully apply to ships, shipboard machinery, arrangements, equipment and materials the documentation on which is submitted to Russian Maritime Register of Shipping for review on the Rules coming into force.

Section 3, Part I "Classification" also fully applies to ships in service. Other requirements of the Rules apply to ships in service as far as it is reasonable and practicable, as well as in cases expressly provided in the Rules.

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PART I. CLASSIFICATION

1 GENERAL

1.1 DEFINITIONS

1.1.1 Definitions relating to general terminology used in normative documents of the Russian Maritime Register of Shipping[1] are given in Part I "Classification" of Rules for the Classification and Construction of Sea-Going Ships and in Part I "General Regulations for Technical Supervision" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

The following definitions have been adopted in Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways)[2] unless expressly provided otherwise in the relevant parts of the Rules.

1.1.2 Types of ships.

B a r g e is a dumb barge or tank barge.

T u g is a ship specially built to perform towing operations.

P u s h t u g is a ship intended both for the towage of self-propelled and non-self-propelled ships as well as for the pushing of non-self-propelled ships.

T o w e d b a r g e is a ship built to be towed, either having no motive power of its own or having only sufficient motive power to perform restricted manoeuvres.

H i g h - s p e e d c r a f t is a motorised craft capable of reaching speeds over 40 km/h in relation to water.

C a r g o s h i p is a ship intended for the carriage of cargoes (dry cargo ships, tankers, combination carriers, refrigerators, etc.).

C a r g o p u s h - s h i p is a ship intended both for the carriage of different cargoes except for liquid cargoes in bulk and for pushing of specially-equipped non-self-propelled ships by push-towing.

C o m b i n a t i o n c a r r i e r is a ship intended for the carriage of crude oil and petroleum products in bulk, as well as bulk cargoes (ore/oil carrier, oil/bulk dry cargo carrier, etc.).

T a n k e r is a ship intended for the carriage of liquid cargoes in bulk including the following types (refer to Fig. 1.1.2):

t a n k e r o f t y p e **N** is a tanker intended for the carriage of liquids;

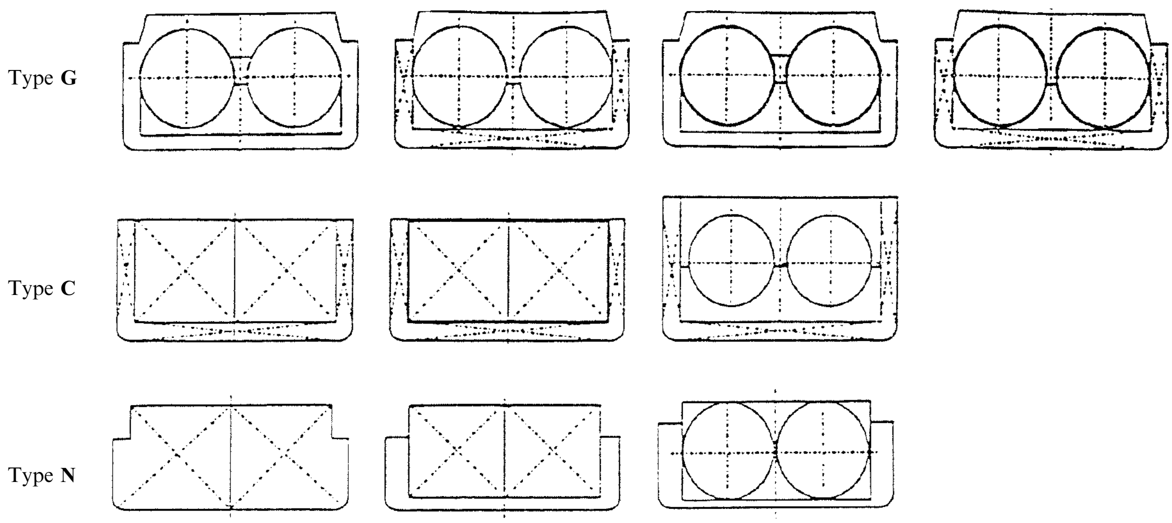


Fig. 1.1.2

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

tanker of type **C** is a tanker intended for the carriage of liquids and is of the flush-deck/double-hull type with double-hull spaces, double bottoms but without trunk. The cargo tanks may be formed by the ship inner hull or may be installed in the hold spaces as independent tanks;

tanker of type **G** is a tanker intended for the carriage of gases under pressure or under refrigeration.

Cabin ship is a passenger ship with overnight passenger cabins.

Passenger sailing ship is a passenger ship built and fitted out also with a view to propulsion under sail.

Passenger ship is a ship constructed and equipped to carry more than 12 passengers.

Floating establishment is any floating installation not normally intended to be moved, such as a swimming bath, dock, jetty or boathouse.

Floating equipment is a floating installation carrying working gear such as cranes, dredging equipment, pile drivers or elevators.

Floating object is a raft or other structure, object or assembly capable of navigation, not being a vessel or floating equipment or establishment.

Recreational craft is a ship other than a passenger ship intended for sport or pleasure.

Inland navigation ship is a ship intended solely or mainly for navigation on inland waterways.

Day-trip ship is a passenger ship without overnight passenger cabins.

Worksite craft is a ship, appropriately built and equipped for use at worksites, such as a reclamation barge, hopper or pontoon barge, pontoon or stone-dumping vessel.

Ship carrying fixed containers is a ship all of whose containers are fixed and having the equipment necessary to secure containers to the satisfaction of the Administration.

Flush-deck ship is a ship which has no superstructure on its freeboard deck.

Shipborne barge (lighter) is a pushed barge built to be carried aboard sea-going ship and to navigate on inland waterways.

Ship's boat is a boat for use in transport, rescue, salvage and work duties.

Dry cargo ship is a ship intended for the carriage of different cargoes (general cargoes, timber, containers, bulk cargoes, etc.) except for liquid cargoes in bulk.

Pushed barge is a barge built or specially modified to be pushed, either having no motive power of its own or having only sufficient motive power to perform restricted manoeuvres when not part of a pushed convoy.

Pusher is a ship specially built to propel a pushed convoy.

1.1.3 Assemblies of ships.

Towed convoy is an assembly of one or more ships, floating establishments or floating objects towed by one or more self-propelled ships forming part of the convoy.

Rigid convoy is a pushed convoy or side-by-side formation.

Formation is the manner in which a convoy is assembled.

Convoy is a rigid or towed convoy of ships.

Side-by-side formation is an assembly of ships coupled rigidly side by side, none of which is positioned in front of the ship propelling the assembly.

Pushed convoy is a rigid assembly of ships of which at least one is positioned in front of the one or two ships providing the power for propelling the convoy, known as the "pusher(s)"; a convoy composed of a pusher and a pushed ship coupled so as to permit articulation is also considered as rigid.

1.1.4 Other definitions.

Administration is the Administration of the country in which the ship is registered or competent authority which issues the ship's certificate.

Basin Administration is the national or international organization that is competent to decide regulations on waterways within a geographical area.

Persons with reduced mobility are persons facing particular problems when using public transport, such as the elderly and the handicapped and persons with sensory disabilities, persons in wheelchairs, pregnant women and persons accompanying young children.

New ship is a ship the keel of which is laid, or which is at a comparable stage of construction on or after the date of entry into force of the Rules.

Recognized classification society is a classification society which has been recognized in accordance with the criteria and procedures stipulated in Annex VII to the Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006.

Shipboard personnel are all employees on board a passenger ship who are not members of the crew.

Ship's certificate is a certificate issued to an inland navigation ship by the competent authority signifying compliance with the technical requirements of the Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006.

Existing ship is a ship in the possession of a valid Classification Certificate of the Register on the day before the entry into force of the Rules.

1.2 EXPLANATIONS

1.2.1 For the purpose of the present Rules, classification means development, publication and application of the Rules, continuous compliance with which, along with proper maintenance of the ship by the shipowner or operator, ensure:

.1 structural strength and integrity of the hull and its elements including structural fire protection;

.2 sufficient reserve of buoyancy and stability of the ship under all specified loading conditions and load distribution lengthwise the ship;

.3 safe and reliable operation of the ship's propulsion plant, systems and devices for the ship's control, other systems, auxiliary machinery, equipment, arrangements and outfit, including fire-fighting equipment;

and thereby allow safe operation of the ship in accordance with its purpose.

1.2.2 The Rules consist of the following parts:

I "Classification";

II "Hull";

III "Equipment, Arrangements and Outfit";

IV "Stability, Subdivision and Freeboard";

V "Fire Protection";

VI "Machinery Installations";

VII "Systems and Piping";

VIII "Machinery";

IX "Electrical Equipment";

X "Automation";

XI "Radio Equipment"

XII " Navigational Equipment";

XIII "Means for the Prevention of Pollution from Ships";

XIV "Requirements for Ships Carring Dangerous Goods".

1.2.3 As regards classification, the Register also applies to inland navigation ships:

.1 the following parts of the Rules for the Classification and Construction of Sea-Going Ships:

Part I "Classification", Section 4 "Classification of Refrigerating Plants";

Part VIII "Systems and Piping", 9.14 "Monitoring the Composition of Atmosphere in Cargo Area";

Part X "Boilers, Heat Exchangers and Pressure Vessels";

Part XII "Refrigerating Plants";

Part XIII "Materials";

Part XIV "Welding";

Part XVI "Hull Structure and Strength of Glass-Reinforced Plastic Ships and Boats";

.2 the following parts of the Rules for the Classification and Construction of Gas Carriers:

Part IV "Cargo Tanks", Section 11 "Construction and Testing";

Part V "Fire Protection", 3.5 "Inert Gas System";

Part VI "Systems and Piping", Section 3 "Cargo System", Section 4 "Cargo Pressure/Temperature Control", Section 5 "Vent Piping System";

Part VIII "Instrumentation";

.3 the following parts of the Rules for the Classification and Construction of Chemical Tankers:

Part VI "Systems and Piping", Section 1 "Cargo Piping System", Section 2 "Cargo Temperature Control", Section 4 "Cargo Tank Venting";

Part VIII "Instrumentation";

.4 Rules for the Classification and Construction of High-Speed Craft as regards inland navigation high-speed craft; Rules for the Classification and Construction of Small Pleasure Craft as regards inland navigation recreational craft.

1.2.4 The Rules take into consideration the provisions of the Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006 establishing technical requirements for inland navigation ships as well as the provisions of the Resolution No.61 of the UN Economic Commission for Europe "Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels" which are applicable for the classification purposes.

1.3 APPLICATION

1.3.1 The requirements of the Rules apply to:

.1 passenger (including sailing) ships and oil tankers, ships intended for the carriage of flammable and other dangerous goods as well as tugs, pushers and cargo push-ships and push-tugs, irrespective of the main engines power output and gross tonnage;

.2 self-propelled ships not specified in 1.3.1.1, with the main engines power output of 55 kW and upwards;

.3 ships not specified in 1.3.1.1 or 1.3.1.2 of 80 gross tonnage and upwards or ships fitted with machinery and equipment with the total prime movers power output of 100 kW and upwards;

.4 materials and products to be manufactured under the Register technical supervision (lists of materials and products are given in the appropriate parts of the Rules).

1.3.2 On agreement with the Register, the Rules may be applied during classification of ships not specified in 1.3.1.

1.3.3 The Rules set forth the requirements upon compliance with which the ship (or the shipboard refrigerating plant) may be assigned a class of the Register.

1.3.4 Confirmation of compliance with the requirements of the Register Rules is the Register prerogative and is performed according to the procedure established by the Register.

Any statements on compliance of the item of technical supervision with the requirements of the Rules, made or documented by a body other than the Register and not properly confirmed by the Register cannot be considered as confirmation of such a compliance.

2 CLASS OF A SHIP

2.1 GENERAL

2.1.1 Assignment of the Register class to the ship means that the ship's structure complies with the applicable requirements of the Rules and its technical condition meets the requirements for the operating conditions of the ship and that the ship is taken under the Register technical supervision for a specified period of time with performing the surveys stipulated by Section 3.

2.1.2 The Register may assign a class to the ship proceeding from the results of technical supervision during construction as well as assign or renew a class to the ship in service.

2.1.3 Renewal of the ship's class means confirmation by the Register that the structure and technical condition of the ship comply with the provisions based on which the class has been assigned as well as extension of the Register technical supervision for a definite period of time as required by the Rules.

2.1.4 Class of the ship is generally assigned or renewed by the Register for six years for self-propelled ships and for eight years for non-self-propelled ships on condition of carrying out intermediate surveys for class confirmation within the above periods, the scope and frequency of which are specified in Section 3.

In sound cases, the Register may assign or renew the class for a shorter period.

2.1.5 If the ship has the valid class of the Register, this means that the ship is under the Register technical supervision specified by the Rules in respect of its technical condition and in full measure or to a degree considered adequate by the Register complies with the applicable requirements of the Rules according to its purpose, service conditions and class notation.

The valid class of the Register is confirmed by the valid Classification Certificate available on board the ship.

2.1.6 The Classification Certificate ceases to be valid, and the class is suspended by the Register in the following cases:

.1 if the ship as a whole or its separate elements have not been submitted to a scheduled periodical or occasional survey on due dates;

.2 after an accident (the ship is to be submitted to an occasional survey at the port where the accident occurred or at the first port of call if the accident took place at sea);

.3 upon structural alterations and/or changes in the ship's equipment reducing the standards required by the Rules not agreed with the Register;

.4 when repair of the ship items has been carried out without the Register approval and/or survey;

.5 when a ship navigates with a draught exceeding that required by the Register as well as in case the ship operates under conditions not complying with the assigned class or the restrictions implied by the Register, including improper loading of the ship in the course of cargo handling operations;

.6 if the prescribed specific requirements which were the condition for assignment or confirmation of the Register class at the previous survey have not been timely met;

.7 if the process of surveying the ship by the Register has been suspended on the shipowner's initiative or through his fault;

.8 when the ship has been taken out of operation for a long period of time (more than three months) for fulfilment of the Register requirements (except the case when the ship is under repair for those purposes).

The shipowner is to be specially notified by the Register of the class suspension and cessation of the Classification Certificate validity.

The class may be suspended for a period of no more than six months.

2.1.7 Suspended class of the ship (refer to 2.1.6) may be reinstated on the basis of satisfactory results of the appropriate periodical or occasional survey carried out by the Register when the ship is submitted to the survey.

During the period from class suspension till its reinstatement it is considered that the ship has been lost the Register class.

2.1.8 The class of the ship is withdrawn by the Register in the following cases:

.1 upon expiration of the maximum term of class suspension;

.2 when the Register and/or shipowner consider reinstatement of the class suspended as stated in 2.1.6 impossible;

.3 upon transfer of the ship to the class of another classification body;

.4 at the shipowner's request.

Withdrawal of the Register class means cessation of the Register technical supervision and cessation of the Classification Certificate validity. The withdrawn class can be re-assigned upon the satisfactory results of the initial survey the scope of which is determined basing on the age of the ship, its technical condition and the time period during which the ship was withdrawn from operation.

2.1.9 The class of the ship is to be cancelled in connection with its loss or scrapping.

2.2 CLASS NOTATION

The class assigned by the Register to the ship or the floating structure consists of the character of classification and distinguishing marks and descriptive notations defining structure and purpose of the ship or the floating structure.

2.2.1 The character of classification consists of distinguishing marks:

KM✪IN KM★IN (KM)★IN — for self-propelled ships and floating structures;

KE✪IN KE★IN (KE)★IN — for non-self-propelled ships and floating structures with total power output of prime movers 100 kW and upwards which are subject to the Register technical supervision;

K✪IN K★IN (K)★IN — for other non-self-propelled ships and floating structures.

2.2.2 Depending on a classification body under which technical supervision and according to which Rules the ship or the floating structure have been built, the character of classification is established as follows:

.1 ships and floating structures built according to the Rules and under the Register technical supervision are assigned a class notation with the character of classification: **KM✪IN KE✪IN K✪IN** (refer to 2.2.1);

.2 ships and floating structures which were as a whole (or their hull or machinery installation, machinery, equipment) built and/or manufactured according to the Rules and under technical supervision of other classification body recognized by the Register are assigned, when classed by the Register, a class notation with the character of classification: **KM★IN KE★IN K★IN** (refer to 2.2.1);

.3 ships and floating structures which were as a whole (or their hull or machinery installation, machinery, equipment) built and/or manufactured without technical supervision of a classification body recognized by the Register or of any classification body at all are assigned, when classed by the Register, a class notation with the character of classification: **(KM)★IN (KE)★IN (K)★IN** (refer to 2.2.1).

2.2.3 Ice category marks.

2.2.3.1 In case the ship is provided with ice strengthening that complies with the requirements of the appropriate parts of the Rules, the distinguishing mark **Ice** is added to the character of classification.

2.2.3.2 The necessity of ice strengthening is determined by the shipowner depending on the intended service conditions.

2.2.4 Subdivision distinguishing marks.

If the ship remains afloat in a satisfactory condition of equilibrium upon flooding of one or two compartments and complies with the appropriate requirements of Part IV "Stability, Subdivision and Freeboard", the distinguishing mark $\boxed{1}$ or $\boxed{2}$ is added to the character of classification.

2.2.5 Distinguishing marks for restricted areas of navigation.

2.2.5.1 As regards classification, the Rules provide for operation of ships classed by the Register in European inland waterways within Zones 1, 2, 3 and 4 established by the Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006 (with the exception of inland waterways of Great Britain and Northern Ireland) and also by the Resolution No.61 of the UN Economic Commission for Europe "Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels" (with the exception of inland waterways of the Russian Federation) (refer to the Appendix).

For the purpose of the Rules, the above zones are characterized by the wave height with 5 per cent probability of exceeding, equal to:

2,0 m for **Zone 1**;

1,2 m for **Zone 2**;

0,6 m for **Zone 3**;

0,3 m for **Zone 4**.

2.2.5.2 With regard to 2.2.5.1, depending on the wave height for which the ship has been built in accordance with the Rules requirements, one of the following distinguishing marks for the restricted areas of navigation is added to the character of classification:

Zone 1 — for ships navigating in areas with the wave height of 2,0 m with 5 per cent probability of exceeding;

Zone 2 — for ships navigating in areas with the wave height of 1,2 m with 5 per cent probability of exceeding;

Zone 3 — for ships navigating in areas with the wave height of 0,6 m with 5 per cent probability of exceeding;

Zone 4 — for ships navigating in areas with the wave height of 0,3 m with 5 per cent probability of exceeding.

2.2.6 Distinguishing automation mark.

If the ship complies with the requirements of Part X "Automation" the distinguishing mark **AUT** is added to the character of classification.

2.2.7 Distinguishing mark for the ship intended for the carriage of refrigerated cargo.

Transport ships intended for the carriage of refrigerated cargo in specially equipped cargo spaces and/or in thermal containers, the distinguishing mark **REF** or **(REF)** is added to the character of classification.

Such ships with the distinguishing mark **REF** in the class notation are to have the refrigerating plant classed by the Register and meeting the applicable requirements of Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships. The distinguishing mark **(REF)** is added to the character of classification of ships using unclassed refrigerating plants complying with the applicable requirements of

Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships.

2.2.8 Descriptive notation in the class notation.

For ships complying with a definite scope of the Rules requirements taking into account their structural peculiarities and service conditions the appropriate descriptive notation is added to the character of classification.

The Rules cover the certain requirements the fulfilment of which allows to add the following descriptive notations to the character of classification:

Bulk carrier
Cargo push-ship
Floating crane
Oil/bulk carrier
Oil tanker
Passenger ship
Pusher
Push tug
Tug, etc.

If the scope of the Rules requirements met by the ship allows, two and more descriptive notations (e.g., **Cargo push-ship**) may be stated in the class notation of the ship or the descriptive notation may be written as a compound (**Oil/bulk carrier**, etc.).

If the oil tanker complies with the requirements for ships carrying petroleum products with a flash point above 60 °C this temperature is by all means to be indicated in the descriptive notation (e.g., **Oil tanker** ($>$60 °C) etc.).

2.3 ADDITIONAL CHARACTERISTICS

2.3.1 When complying with the definite requirements of the Rules stipulated by the structural features or operational characteristics of the ship, the fulfilment of which is not reflected by distinguishing marks and descriptive notation in the class notation, the compliance of the ship with such requirements is confirmed by the entry in column "Other characteristics" of the Classification Certificate stating, for example, that the ship as a whole or its separate cargo spaces are equipped for the carriage of dangerous goods of classes ..., or a ship is equipped for the carriage of cargo in international standard containers on deck and/or in the appropriate holds, or that the ship is suitable for operation in waters covered with oil, etc.

2.4 ALTERATION OF MARKS IN CLASS NOTATION

2.4.1 The Register may delete or alter any mark in class notation in case of any alterations or violation of the conditions that provided the basis for adding the mark to the class notation.

2.5 DOCUMENTS ISSUED BY THE REGISTER TO THE SHIP

2.5.1 The Register class is confirmed by issue to the ship of the Classification Certificate according to the set form.

2.5.2 Any other ship's documents issued by the Register on behalf of the ship's Flag Administration are to be drawn up on conditions and according to the form specified in the authorization.

2.5.3 Along with the Classification Certificate referred to in 2.5.1, the following documents developed by the designer or shipowner and approved by the Register are to be submitted to the ship:

.1 Information on Damaged Trim and Stability;
.2 Loading Manual;
.3 Emergency, Fire and Environmental Safety Plan.

The requirements for contents of the above documents are given in the relevant parts of the Rules.

3 CLASSIFICATION SURVEYS OF SHIPS AND FLOATING STRUCTURES IN SERVICE

3.1 INITIAL SURVEY FOR CLASS ASSIGNMENT

3.1.1 The initial survey for class assignment is intended for determining the possibility to assign a class to the ship initially submitted to the Register for classification.

The scope of the survey is to be each time determined by the Register according to Table 3.2.3 for the appropriate special class renewal survey depending on the age of the ship and having regard to the technical condition of hull, machinery and arrangements (refer also to 3.5).

3.2 PERIODICAL SURVEYS

3.2.1 A special survey for class renewal is to be carried out upon the class expiry (refer to 2.1.4) and aims to ascertain that technical condition of the ship meets the requirements of the Rules.

At the request of the shipowner, individual items of supervision may be surveyed within the scope of a special survey after the number of their working hours has reached the figure specified by the manufacturer or basing on the reliable results of operation experience. During a special survey of the ship as a whole such items may be surveyed within the scope of annual survey.

3.2.2 In the intervals between special (initial and special) surveys intermediate surveys are to be carried out to ascertain that the ship meets the conditions for class retainment to a sufficient extent and to check the operation of machinery, arrangements and equipment covered by the Rules requirements.

Intermediate surveys of passenger ships, ships operated in ice, oil tankers, ships engaged in the carriage of dangerous goods, dynamically supported craft and air-cushion vehicles are to be carried out at intervals of 12 months, other ships are to be surveyed at intervals of 24 months from a special or initial survey (refer also to 3.2.3).

3.2.3 Surveys for confirmation of class are to be carried out with intervals referred to in 3.2.2 within three months before or after the anniversary dates but with no effect on the dates of the subsequent special surveys.

3.2.4 The scope of periodical surveys is given in Table 3.2.3. The scope of individual inspections, measurements, tests, etc. is determined by a surveyor to the Register depending on the existing instructions and particular circumstances.

The scope of periodical surveys for ships referred to in 2.2.2.2 and 2.2.2.3 is to be not less than that indicated in Table 3.2.3. Where necessary, the surveyor to the Register may require to extend the scope of surveys for those ships.

The fourth and subsequent special surveys of the ship's hull are carried out in the scope prescribed for the third special survey. The scope of examinations, thickness measurements and tests for watertightness is required by the surveyor, having regard to the previous repairs and replacements of hull structures.

3.2.5 At a special survey those surveys of the items (including dock survey) which were carried out in the scope required no more than six months before the date of the special survey may be omitted.

Such items are to be surveyed in the scope required for class confirmation.

Table 3.2.3

SCOPE OF PERIODICAL SURVEYS OF SHIPS

Symbols:
O — examination with access, opening or dismantling of individual items, if necessary;
C — external examination;
M — measurements of wears, clearances, insulation resistance, etc.;
H — pressure tests (hydraulic, pneumatic);
P — operation tests of machinery, equipment and arrangements, external examination;
E — control of the availability of valid documents and/or stamps to confirm that instruments have been checked by the appropriate competent authorities, if subject thereto.

Nos	Item to be surveyed	Periodical surveys			
		Intermediate for class confirmation (see 3.2.2)	I special	II special	III special
1	2	3	4	5	6
1	**Hull**				
1.1	Underwater hull (external examination) [1]				
1.1.1	Keel, stem, sternframe, shaft brackets, rudders	C	O	O	O
1.1.2	Shell plating	C	O	OM[2]	OM[2]
1.1.3	Sea chests, welded-on branches under sea chests	C	O	OM[3]	OM[3]
1.2	Above-water hull (external examination)				
1.2.1	Stem, sternframe	C	O	O	O
1.2.2	Shell plating	C	O	OM[2]	OM[2]
1.2.3	Upper deck plating	C	O	OM[2]	OM[2]
1.2.4	Superstructure and deckhouses, machinery casings (deck plating, bulkheads), hatch and ventilator coamings	C	O	O	O
1.2.5	Seatings of deck machinery	C	O	O	O
1.2.6	Bulwark and hand rails	C	O	O	O
1.3	Inner compartments [4]	C	C	C	C
1.3.1	Forward and aft ends		O	O	O
1.3.2	Tanks being an integral part of the hull (including double bottom tanks) together with air and sounding pipes:				
	.1 fresh water, ballast, drain tanks		O	OH[5]	OH[5]
	.2 fuel oil, lubricating oil tanks		OH[6]	OH[6]	OH[6]
1.3.3	Cargo holds:				
	.1 for dry cargoes	C	O	O	O
	.2 cargo tanks together with air and sounding pipes		OH	OH	OH

Table 3.2.3 — continued

1	2	3	4	5	6
1.3.4	Machinery spaces:				
	.1 main and auxiliary machinery spaces, boiler rooms, trunks to those spaces	C	O	O	O
	.2 seatings of main and auxiliary machinery, boilers		O	O	O
1.3.5	Other spaces in hull and superstructures		O	O	O
1.3.6	Load line	C	C	C	C
2	**Arrangements, equipment and outfit**				
2.1	Hatch covers, manhole closures, outside doors, side scuttles, doors in watertight bulkheads	C	OH[7]	OH[7]	OH[7]
2.2	Steering gear	C	O[8]	O[8]	O[8]
2.2.1	Rudder blade, steering nozzle, rudder tube	CM[9]	OM[9]	OM[9]	OM[9]
2.2.2	Rudder stock, pintles, bearings, couplings				
2.2.3	Main and auxiliary steering gear with control system and stations, rudder angle indicators, rudder stop	P	O	O	O
2.3	Anchor arrangement	P	P	P	P
2.3.1	Anchors and hawse pipes	C	O	O	O
2.3.2	Chain cables and wire ropes	C	OM	OM	OM
2.3.3	Stoppers and chain cable releasing devices	P	OP	OP	OP
2.4	Mooring arrangement		O	O	O
2.5	Towing and pushing arrangement:				
	.1 hook with fastening and equipment	O	OP	OP	OP
	.2 hoop [10]		O	O	O
	.3 bollards and ropes	C	O	O	O
	.4 pushing bitts		O	O	O
	.5 coupling device	C	O	O	O
2.6	Live-saving appliances				
2.6.1	Launching devices [11]	P	OP	OP	OP
2.6.2	Lifeboats [11]	P	OP	OP	OP
2.6.3	Rigid liferafts and buoyant apparatus [11]	O	O	O	O
2.6.4	Inflated liferafts and life jackets [12]	CE	CE	CE	CE
2.6.5	Life buoys and life jackets	C[12]	C[12,13]	CE[12,13]	CE[12,13]
2.7	Signal means				
2.7.1	Navigation lights	P	OP	OP	OP
2.7.2	Sound signal means	P	P	P	P
2.8	Navigational equipment	P	OP	OP	OP
3	**Fire protection**				
3.1	Structural fire protection				
3.1.1	Fire-resisting and fire-retarding constructions and closures of openings therein	C	C	C	C
3.1.2	Closures of outer openings (vent ducts, skylights of engine and boiler rooms, etc.)	P	P	P	P
3.2	Fire extinguishing systems				
3.2.1	Water fire main system, water screen system, water-sprinkling system, pressure water-spraying system, foam fire extinguishing system [14], sprinkler system	OPH	P	OPH	OP
3.2.2	Carbon dioxide smothering system, inert gas smothering system	PEH	PE	OPEH[49]	PE
3.3	Fire detection and alarm system [50]	P	P	P	P
3.4	Fire-fighting outfit [15]	PE	PE	PE	PE
3.5	Liquefied-gas household units [16]	E	EH	EH	EH
3.6	Instrumentation	E	E	E	E
4	**Machinery installations**				
4.1	Main internal combustion engine [17]	P	P	P	P
4.1.1	Frame:				
	.1 bed plate, crankcase, columns, blocks, tie rods, cylinder covers, cylinder cover pins		O	O	O
	.2 cylinder liners [18]		OM	OM	OM
4.1.2	Piston assembly:				
	.1 pistons, gudgeon pins, connecting rods		OM	OM	OM
	.2 top-end and bottom-end bearings and their bolts [19]		OM[20]	OM[20]	OM[20]
4.1.3	Crankshaft:				
	.1 journals and crank pins		OM	OM	OM
	.2 main bearings and their studs		O	O	O
	.3 crank web deflection		M	M	M

Table 3.2.3 — continued

1	2	3	4	5	6
	.4 crankshaft sag (for engines with crankshafts placed on bushes filled up with babbit)	M	M	M	M
4.1.4	Distributing devices (valve drives, suction, exhaust and starting air valves)		O	O	O
4.1.5	Safety valves (of cylinder covers, fuel oil pumps, crankcase hatches)		P[21]	P[21]	P[21]
4.1.6	Lubricating devices (lubricators, etc.)		P	P	P
4.1.7	Gear and disengaging couplings:				
	.1 casings, reamed bolts and chocks		O	O	O
	.2 shafts and bearings		OM	OM	OM
	.3 pinions and gear wheels (gearing contact)		OM	OM	OM
	.4 engagement parts		M	M	M
	.5 shaft positions — journal and thrust bearings clearances		M	M	M
4.1.8	Manoeuvring and starting devices, remote control arrangements	P	OP	OP	OP
4.1.9	Speed governor and overspeed device	P[22]	P[22]	P[22]	P[22]
4.1.10	Main-engine driven auxiliary machinery [23]				
	.1 cooling water, lubricating oil, bilge and fuel oil booster pumps		OP	OP	OP
	.2 compressors				
	2.1 compressors air coolers		OP	OP	OPH[24]
	.2.2 safety valves		P	P	P
	.2.3 purging pumps, turboblowers		OP	OP	OP
4.1.11	Shaft turning gear		OP	OP	OP
4.2	Auxiliary internal combustion engines:	P	P	P	P
	.1 cylinders, pistons with connecting rods and their bearings, crankshafts and main bearings, covers and valves	P	OM	OM	OM
	.2 speed governor and overspeed device		P	P	P
4.3	Instrumentation	E	E	E	E
4.4	Shafting and propeller [23]				
4.4.1	Thrust shaft:				
	.1 journals, thrust collars and flanged joints		OM	OM	OM
	.2 journals and thrust bearings		O	O	O
	.3 reamed bolts and chocks of thrust bearing		O	O	O
	.4 axial clearance [25]	M	M	M	M
	.5 shaft alignment [26]				
4.4.2	Intermediate shafts:				
	.1 journals, journal bearings, flanged and coupling joints;		OM	OM	OM
	.2 reamed bolts and chocks of bearings		O	O	O
	.3 shaft alignment [26]				
4.4.3	Propeller shaft [27]	O[28]P[23]	O[28]P[23]	O[28]P[23]	O[28]P[23]
	.1 journals	M[28]	M[28]	M[28]	M[28]
	.2 propeller cone [29]	O	O	O	O
	.3 stern-tube and bracket bearing clearances [30]	M	M	M	M
	.4 journal bearings	O[28]	O[28]	O[28]	O[28]
	.5 stern tube	O[31]	O[31]	O[31]	O[31]
	.6 propeller shaft seal [24]	OH	OH	OH	OH
	.7 flanged and coupling connections	O[28]	O	O	O
4.4.4	Propeller [32]:		OH	OH	OH
	.1 static balancing [33]				
	.2 propeller shaft fitting (adjusting) [34]				
	.3 parts of controllable-pitch propeller, Voith-Schneider and steerable propellers				
	.4 propeller securing (locking) [28]				
4.4.5	CPP control systems	P	OPH	OPH	OPH
4.5	Auxiliary machinery				
4.5.1	Pumps (circulating, boiler water, bilge, cooling water, feed water, ballast water, fire, fuel oil, lubricating oil pumps), generators and pumps of hydraulic drives	P	OMP	OMP	OMP
4.5.2	Fuel oil and lubricating oil centrifugal separators [35]	P	OP	OP	OP
4.5.3	Compressors:	P	P	P	P
	.1 cylinders, crankshaft and main bearings, cylinder covers and valves		OM	OM	OM
	.2 air coolers				H[24]
	.3 safety valves	P	P	P	P
4.5.4	Fans of dangerous spaces	P	OP	OP	OP
4.5.5	Steering gear	P	OMP	OMP	OMP
4.5.6	Anchor machinery	P	OMP	OMP	OMP
4.5.7	Mooring machinery	C	P	P	P

Table 3.2.3 — continued

1	2	3	4	5	6
4.5.8	Boat winches	P	OMP	OMP	OMP
4.5.9	Towing winch with arrangements (for tugs)		OMP	OMP	OMP
4.5.10	Machinery of coupling devices		OMP	OMP	OMP
4.5.11	Mechanical telegraphs	P	P	P	P
4.5.12	Instrumentation	E	E	E	E
5	**Boilers, heat exchangers and pressure vessels**				
5.1	Boilers:				
5.1.1	Gas-tube boilers [36,37,38]	P	OMP	OMPH	OMP
5.1.2	Gas-and-water-tube boilers [36,37,38]	P	OMP	OMPH	OMP
5.1.3	Water-tube boilers [36,37,39]	P	OP	OPH	OP
5.1.4	Waste-heat [36,37]	P	OP	OPH	OP
5.1.5	Organic-coolant boilers		OPH	OPH	OPH
5.1.6	Boiler fittings	P	OP	OHP	OP
5.1.7	Safety valves	P	OP	OHP	OP
5.1.8	Instrumentation	E	E	E	E
5.2	Heat exchangers and pressure vessels				
5.2.1	Heat exchangers and their fittings:	P	OPH[40]	OHP	OPH[40]
	.1 safety valves	P	P	P	
5.2.2	Air receivers and other pressure vessels and their fittings	P	OPH[40]	OHP	OPH[40]
	.1 safety values	P	P	P	P
5.2.3	Instrumentation	E	E	E	E
6	**Automation** [41,42,43]				
6.1	Systems (together with alarm and protection systems):				
6.1.1	Centralized automatic control of machinery installation	P	OP	OP	OP
6.1.2	Remote automated control, remote control of main engines and CPP	P	OMP	OMP	OMP
6.1.3	Automatic and automated control of electric generating plant	P	OMP	OMP	OMP
6.1.4	Automatic control of steam boilers	P	OMP	OMP	OMP
6.1.5	Control systems of lubricating oil temperature, cooling medium and fuel oil (fuel oil viscosity) and automatic filter cleaning	P	OMP	OMP	OMP
6.1.6	Compressor automation	P	OMP	OMP	OMP
6.1.7	Automation of fuel oil and lubricating oil separators	P	OMP	OMP	OMP
6.1.8	Automated control of valves and devices in the ship's service systems	P	OMP	OMP	OMP
7	**Systems and piping**				
7.1	Bottom and side fittings and fittings installed on watertight bulkheads	OP	OP	OHP	OHP
7.1.1	Fittings located below waterline [44]	P	OP	OHP	OHP
7.1.2	Fittings located above waterline	P	PO	PO	PO
7.1.3	Remote-controlled fittings	C	O	O	O
7.1.4	Flame arresters and flame restricting fittings of vent pipes	C	O	O	O
7.1.5	High-velocity devices of vent pipes on oil tankers, combination carriers and other ships	O	OM	OHM	OHM
7.1.6	Welded branches for bottom and side fittings				
7.2	Systems and piping				
7.2.1	Water systems:				
	.1 bilge, ballast, cooling water and feed water	P	OP	OP	OPM
	.2 pipes passing through fuel oil tanks and liquid cargo tanks without pipe ducts [45]		OH	OH	OH
	.3 scuppers running through sides, decks and bulkheads		O	O	O
7.2.2	Liquid and gas fuel systems:				
	.1 gas fuel pipes	P	OP	OP	OP
	.2 automatic- and remote-controlled valves	P	OPH	OPH	OPH
	.3 liquid fuel pipes, remote-controlled valves	P	OP	OP	OP
	.4 independent fuel oil tanks	C	O	OH[46]	OP
7.2.3	Liquid cargo systems on oil tankers [47]	C	O	O	O
7.2.4	Compressed air system	P	OP	OPH	OP
7.2.5	Lubricating oil system:				
	.1 pipes	P	OP	OP	OP
	.2 independent tanks	C	O	OH[46]	OP
7.2.6	Steam systems:				
	.1 boiler pressure live steam and boiler blowoff	P	OP	OPH[46]	OP
	.2 reduced pressure live steam		OP	OP	OP

Table 3.2.3 — continued

1	2	3	4	5	6
7.2.7	Air, gas vent, overflow and sounding pipes	C	O	O	O
7.2.8	Gas vent systems on oil tankers	C	OP	OP	OP
7.2.9	Ventilation system:				
	.1 ventilation ducts running through watertight and fire-proof divisions	P	O[48]P	O[48]P	O[48]P
	.2 ventilation system of dangerous spaces	P	O[48]P	O[48]P	O[48]P
	.3 exhaust ventilation system of gas fuel pipe ducts	P	OP	OP	OP
7.2.10	Hydraulic drive system	P	OP	OP	OP
7.2.11	Instrumentation	E	E	E	E
8	**Electrical equipment**				
8.1	Power and lighting equipment [51]				
8.1.1	Electric propulsion plants:				
	.1 main generators, exciters, electric propulsion motors and electromagnetic clutches	P	OMP	OMP	OMP
	.2 switchboards	OP	OEMP	OEMP	OEMP
	.3 control and monitoring desks	P	OEMP	OEMP	OEMP
8.1.2	Electrical power sources for the ship's mains (main and emergency)	P	OMP	OMP	OMP
8.1.3	Converting devices feeding essential consumers	P	OMP	OMP	OMP
8.1.4	Switchboards:				
	.1 main and emergency switchboards	OP	OEMP	OEMP	OEMP
	.2 navigation lights switchboards	OP	OEMP	OEMP	OEMP
	.3 section and group distribution switchboards	O	OMP	OMP	OMP
8.1.5	Cabling:				
	.1 cables and wires	M	OM	OM	OM
	.2 cable protection (additional), passage of cables through watertight and fire-proof bulkheads and decks		O	O	O
8.1.6	Electric drives of essential consumers and their control, protective, starting and regulating devices:				
	.1 pumps referred to in 4.5.1, compressors, anchor arrangement	P	OMP	OMP	OMP
	.2 steering gear	OP	OMP	OMP	OMP
	.3 mooring machinery		OP	OP	OP
	.4 towing winch		OP	OP	OP
8.1.7	Lighting:				
	.1 rooms and spaces essential for safety and propulsion of the ship and habitability of people on board the ship	P	OP	OP	OP
	.2 other spaces		OP	OP	OP
	.3 navigation lights, emergency lighting	OP	OP	OP	OP
8.1.8	Electric heating equipment for machinery installations and electric heating appliances for spaces	P	P	P	P
8.1.9	Electrical cables and equipment in dangerous zones	OM	OM	OM	OM
8.2	Signaling devices and of intercommunication system protection				
8.2.1	Electric engine telegraph, essential electric signaling system, service telephone communication	P	OP	OP	OP
8.2.2	Ventilation system for CO_2 container rooms, spaces protected by CO_2 and accumulator rooms	P	OP	OP	OP
8.2.3	Lightning protection device, earthing	C	O	O	O
9	**Unclassed refrigerating plants**				
9.1	Refrigerating plant as a whole [52]	P	P	P	P
9.2	Compressors:	P	P	P	P
	.1 safety valves	P[53]	P[53]	P[53]	P[53]
	.2 crankcase, casing			OH[52]	OH[52]
9.3	Heat exchangers and other apparatus and pressure vessels for refrigerant:	P	P	OH[51]	OH[51]
	.1 safety valves	P[53]	P[53]	P[53]	P[53]
9.4	Fittings and pipes:				
	.1 refrigerant	P	OP	OPH[52]	OPH[52]
	.2 bottom and side fittings (refer to 7.1.1, Table 3.2.3)				
9.5	Water-screen and drenching system in refrigerating machinery room	P	OP	OP	OP
9.6	Freezing and cooling apparatus	P	P	PH[54]	PH[54]
9.7	Ventilation of refrigerating machinery room, refrigerant store rooms and processing equipment spaces	P	OP	OP	OP
9.8	Instrumentation	E	E	E	E
9.9	Automatic protection of compressors equipment	P	P	P	P

Table 3.2.3 — continued

1	2	3	4	5	6
10	**Equipment and arrangements for the prevention of pollution by oil**				
10.1	Holding tanks		OMH	OMH	OMH
10.2	15 ppm bilge separator	P[55]	OMHP[55]	OMHP[55]	OMHP[55]
10.3	Safety valves	P	OP	OP	OP
10.4	15 ppm bilge alarm	MP	EMP	EMP	EMP
10.5	Oil-containing bilge water and oil residues pumping, collecting and discharge arrangements	P	OHP	OHP	OHP
10.6	Instrumentation	E	E	E	E
11	**Equipment and arrangements for the prevention of pollution by sewage**				
11.1	Sewage treatment plant		OMHP[56]	OMHP[56]	OMHP[56]
11.2	Holding tanks		OMH	OMH	OMH
11.3	Sewage collecting, storage and discharge system		OHP	OHP	OHP
11.4	Instrumentation		E	E	E
12	**Equipment and arrangements for the prevention of pollution by garbage**				
12.1	Incinerators	P	OMP	OMP	OMP
12.2	Garbage receptacles	C	C	C	C
12.3	Instrumentation	E	E	E	E
13	**Equipment and arrangements for the prevention of air pollution**				
13.1	Engines covered by 6.3, Part XIII "Means for the Prevention of Pollution from Ships"	O	OM	OM	OM
13.2	Exhaust gas cleaning system to reduce emissions	P	OMP	OMP	OMP
13.3	Volatile organic compounds vapours collecting system	P	OP	OP	OP
13.4	Incinerators	P	OMP	OMP	OMP
13.5	Instrumentation	E	E	E	E

Notes:

[1] The following ships are to be submitted to survey of the underwater part of the hull:
ships operated in ice, dynamically supported craft and air-cushion vehicles — annually;
self-propelled ships — at each special survey and once within ± 9 months from the middle of the period between special surveys, except for the first period after completion of construction;
non-self-propelled oil tankers — at each special survey, beginning from the second survey;
other non-self-propelled ships — at each special survey, beginning from the third survey.

[2] M — residual thickness measurements, beginning from the second special survey, of coamings, shell plating and upper deck plating for cargo tank areas on oil tankers as well as shell plating, coamings, deck plating, platforms, inner bottom plating with framing members having mastic, wooden, etc. coverings, for all ships and for the areas not indicated above beginning from the third special survey are to be carried out at all special surveys in the scope specified by the surveyor depending on the technical condition of the item. Residual thickness measurements of welded-on branches are to be carried out beginning from the second special survey, at each docking.

[3] M — residual thickness measurements, beginning from the second special survey, in the scope specified by the surveyor depending on the technical condition of the item.

[4] Shell plating, deck plating, platforms and inner bottom plating; bottom, side and deck framing, pillars, watertight bulkheads and recesses, trunks and tunnels are to be surveyed from inside the spaces. Residual thickness of the above items is to be measured according to note 2.

[5] Testing afloat may be allowed provided internal examinations are also carried out afloat.

[6] Fuel oil or lubricating oil testing may be performed afloat.

[7] Testing depending on the closer type.

[8] If substantial wear is shown by inspection results, residual thickness of plates is to be measured.

[9] Measurements (clearances in bearings and rudder sag) are to be carried out at each dock survey of the ship.

[10] Only on tugs and push-boats.

[11] When determining technical condition in terms of strength and watertightness, the surveyor may request testing of launching devices or boats by a test load or checking of watertightness of boats, their air-buoyancy tanks or compartments of rigid liferafts and buoyant apparatus.
Such tests and checking are mandatory at special surveys of ships for boats, rigid liferafts, buoyant apparatus and launching devices of 12 years of age and over.

[12] Check of documentation on periodical surveys and tests carried out at a servicing station and proper branding of lifejackets and sealing of liferafts.

[13] Check of maintaining dimensions, quality of the filler, testing for buoyancy and strength.

[14] Check of availability of the necessary amount of fire extinguishing medium, branding of containers and cylinders by competent bodies, documents confirming suitability of fire extinguishing medium for application (for foam concentrate — in three years beginning from the date of manufacture and then annually).

[15] Operation tests of motor pumps and portable foam sets. Checking of the availability of the document issued by a competent body confirming the specified characteristics of fire extinguishers, breathing apparatus, gas analyzers. Fire extinguishers are to be surveyed at least once every two years.

[16] Surveys and tests of liquefied-gas household units are to be carried out by the shipowner's specialists. Before putting into service after each modernization or repair and in case of each renewal of the unit's Certificate the liquefied-gas household units are to be

Table 3.2.3 — continued

approved by a survey commission or a specialist authorized by the shipowner. The maximum period of validity of the above Certificate is three years.

[17] During a special survey a functional test is to be carried out during sea trials. At class confirmation survey readiness for operation, good condition of manoeuvring and starting devices, remote control devices, as well as attached and driven machinery is to be checked; in this case, operation of the machinery at a speed, load or other parameters is not required.

[18] Cylinder liners are to be checked with a magnetic flaw detector or by another approved method for cracks in way of the upper landing shoulder and in the area of exhaust ports.

[19] Connecting rod bolts of four— and two-stroke double-action engines after 20000 hours of operation as well as in doubtful cases are to be checked with a magnetic flaw detector or another approved method for fatigue cracks.

[20] At special survey length of big-end bearing bolts is to be measured.

[21] Checking of adjustment.

[22] Functional tests only for main machinery driving a propeller through a disengaging arrangement or CPP.

[23] Functional test is to be carried out only during functional tests of the main machinery.

[24] H — every 12 years.

[25] M — once every two years.

[26] M — an axial clearance in the thrust bearing is to be checked at every intermediate survey with docking and at special survey.

[27] Interval between thorough surveys are to be three years for single-shaft ships and four years for multi-shaft ships. However, it may be increased to five years for ships approved by the Register (besides ships engaged in ice-breaking operations).

For oil-lubricated shafts, stern-tube seals of which can be replaced by new ones without dismantling of the propeller, a modified (reduced) survey may be carried out instead of thorough survey at each second survey with a six-year (maximum) interval provided the clearances in the aft bearing are in normal condition and oil seals proved to be effective.

At the Shipowner's request, for oil-lubricated shafts to which a reduced survey is applicable, the interval between thorough surveys may be increased, provided a partial survey has been held; however, the interval is not to exceed 1,5 times the prescribed interval.

For oil-lubricated shafts to which a modified survey is applicable, an interval between thorough surveys may be increased:

up to 9 years, provided a partial survey has been held;

up to 12 years and in justified cases up to 15 years, provided partial surveys have been held and a monitoring system of propeller shaft condition has been introduced and its application is endorsed in the Classification Certificate.

[28] After dismantling of the propeller and removal of the shaft from the stern tube.

[29] The propeller shaft cone for the propeller and half-coupling is to be checked by a magnetic flaw detector for cracks.

[30] Also at every docking.

[31] O — also at every removal of the shaft.

[32] O — at survey of the propeller shaft; C — at every docking. At every dismantling, tightening and locking are to be checked. At every docking the propeller is to be checked for cracks by an approved method.

[33] M — at every propeller repair.

[34] O — at every dismantling.

[35] O — magnetic flaw detection (for separators manufactured without the Register technical supervision — annually).

[36] O — interval between internal examinations before the second special survey is to be three years (± 6 months); M — fire tubes only.

[37] H — boiles inaccessible for internal examination are to be hydraulically tested at every special survey of the ship.

[38] Incinerators are to be surveyed in accordance with Table 2.2.1, Part I "Regulations for Technical Supervision" of Guidelines on the Applications of Provisions of the International Convention MARPOL 73/78.

[39] Main water-tube boilers where two or more of them are installed on board the ship are to be internally examined at every second annual survey.

[40] H — only for apparatus and ships inaccessible for internal examination and ships filled with exhaust gas.

[41] Survey may be carried out within the scope of the special programme intended for the particular design of ships and approved by the Register.

[42] The automation equipment listed is subject to survey if it is used to improve reliability in connection with specific features of a particular design of ships (e.g., regulation systems, alarm and signalling systems and protection of steam water-tube boilers, high-speed engines that can be remote-operated only, remote automatic control of ballast, cargo and other systems where their fittings are installed in tunnels, etc.).

[43] Special and annual surveys of automation equipment are to be carried out concurrently with survey of machinery within the time periods indicated in the present Table.

[44] H — at every special survey beginning from the second one; O — at every docking with sea valves and shut-off fittings being dismantled.

[45] H — in two years in case the pipes have detachable connections inside the tanks.

[46] H — in 12 years.

[47] Before the survey, cargo systems are to be gas-freed. Where necessary, pipe thickness is to be measured and pipes are to be hydraulically tested at the surveyor's discretion.

[48] For oil tankers, oil recovery ships, combination carries, gas tankers and chemical carriers only.

[49] At least 10 per cent of high-pressure CO_2 containers are to be hydraulically tested.

[50] Availability of the document issued by a competent body confirming the regulated characteristics of fire detectors or the ship's report of their testing using special arrangements is to be checked. Warning alarms for CO_2 system are to be tested at least once every two years.

[51] Insulation resistance of the ship's mains, essential electrical machinery and devices is to be measured during class confirmation survey. At special surveys insulation resistance of all the ship's mains and fixed electrical machinery and devices is to be measured.

[52] Tightness test by a gas pressure after each dismantling and assembling of the plant.

[53] P — adjustment test.

[54] H — pneumatic tests at every special survey of the ship beginning from the second survey after completion of construction.

[55] During annual surveys the results of sample analyses carried out by a recognized laboratory are to be submitted. During initial and special surveys samples are taken in the presence of a surveyor to the Register after which the results of the sample analyses carried out by a recognized laboratory are to be submitted.

[56] To confirm the compliance of the plants with the sanitary norms and requirements the state sanitary authorities conclusion is to be submitted.

3.3 OCCASIONAL SURVEYS

3.3.1 Occasional surveys of the ship or separate items of its machinery, installations, equipment or outfit are to be carried out in all cases when the ship is submitted to surveys, other than periodical surveys.

The scope of surveys and their procedures are to be determined by the Register depending on the purpose of the survey, age and technical condition of the ship.

3.3.2 A survey of the ship after an accident is to be carried out in case a damage has been sustained by the ship's hull, machinery, arrangements, installations, equipment or outfit covered by the Rules requirements and subject to technical supervision by the Register, as well as in case of grounding that gives reason to assume that the above damages could occur. The survey is to be carried out in the port where the ship is at the moment or in the first port which the ship calls at after the accident. This survey aims to detect damages, to agree upon the scope of work required to eliminate the consequences of the accident and to determine the possibility and conditions of class retainment.

The Register is to be notified of any accident sustained by the glass-reinforced plastic ship that resulted in a hull damage.

3.3.3 Occasional surveys are carried out at the request of the shipowner or underwriter in the scope necessary to meet their request.

3.4 EXTENSIONS OF PERIODICAL SURVEYS

3.4.1 In sound cases, at the shipowner's request the Register may grant extension of a special survey of the ship for class renewal for a time period not exceeding six months for self-propelled ships and not exceeding 12 months for non-self propelled ships, provided the ship is submitted to the occasional survey the scope of which is to be determined according to the scope of class confirmation survey. In sound cases, during special survey the Register may grant extension of some types of surveys of the items for a period of time not exceeding 12 months, provided the items are submitted to the occasional survey the scope of which is to be determined according to the scope of class confirmation survey.

3.4.2 In sound cases, internal surveys of boilers validity period may be extended for three months.

Hydraulic tests of boilers as well as internal surveys and hydraulic tests of heat exchangers and pressure vessels to be carried out during the special survey of the ship may be extended for a time period up to 12 months, provided the boilers are submitted to the internal survey and heat exchangers and pressure vessels — to the external examination.

3.5 CLASSIFICATION OF SHIPS HAVING CLASS OF ANOTHER CLASSIFICATION BODY AND SHIPS WITH NO CLASS ASSIGNED

3.5.1 The Register may classify the ship which has not been classified earlier or which class assigned by another classification body has become invalid, provided the ship is submitted to the initial survey for class assignment.

3.5.2 The ship having the valid class of another classification body may be classified by the Register provided the ship is submitted to the initial survey in the scope of a class confirmation survey. Upon satisfactory results of the survey the Register may assign a class to the ship for a period of validity of the Classification Certificate available on board the ship.

3.5.3 For the classification of the ship having a valid class of another classification body or the ship which class assigned by another classification body has become invalid, the following documents are to be submitted:

.1 the latest Classification Certificate and Seaworthiness Certificate, if necessary;

.2 Survey Reports issued by surveyors to the previous classification body for a period from the last special survey for class renewal;

.3 detailed descriptions (specifications);

.4 general arrangement plan;

.5 midship section or representative structural cross-section drawings;

.6 construction profile;

.7 shell expansion;

.8 drawings of decks and watertight bulkheads;

.9 drawings of stem and sternframe, rudder and rudder stock;

.10 Information of Stability (for ships where the Information is required);

.11 drawings of fire-fighting divisions, systems and equipment;

.12 general arrangement plan of machinery, boilers and equipment in engine and boiler rooms and in emergency sources of electrical power spaces (with indication of escape routes);

.13 drawing of shafting and stern tube;

.14 piping diagrams (including sounding, air and overflow pipes);

.15 circuit diagrams of electrical networks, as well as main and emergency switchboards.

If the shipowner cannot submit some the above documents he is to ensure that the Register receives all the necessary information at the initial survey for class assignment.

3.5.4 When the ship in service with no class assigned is submitted to the Register classification, the scope of technical documentation to be submitted is to be agreed with the Register in each case.

3.6 DATES FOR PERIODICAL SURVEYS

3.6.1 Dates for periodical surveys of the ship classed by the Register are to be counted off the date of the Classification Certificate issue. If the ship was launched more than a year before the completion of the initial survey, the ship is to be submitted to inspection of the under-water part of the hull or the date of the next special survey will be counted off the date of the ship's launching.

3.6.2 Dates for periodical surveys of the ship in service are counted off the date of completion of the special survey for class renewal that is considered to be the date of the Classification Certificate issue.

3.6.3 Dates for periodical surveys of the ship having a valid class of another classification body and then classed by the Register during the class confirmation survey are to be counted off the date of the Classification Certificate issuing by the classification body which class was originally assigned to the ship.

3.6.4 Dates for periodical surveys of the ship which has not been classed earlier are to be counted off the date of class assignment.

3.7 REINSTATEMENT OF CLASS

3.7.1 On the shipowner's request, each ship which Classification Certificate became invalid may be submitted to the occasional survey for class reinstatement.

The scope of the survey is determined by the Register in each particular case.

4 TECHNICAL DOCUMENTATION OF A SHIP

4.1 TECHNICAL DESIGN DOCUMENTATION OF A SHIP UNDER CONSTRUCTION

4.1.1 General.

Prior to the beginning of the ship's construction technical design documentation proving that the requirements of the Rules applicable to the ship concerned are met is to be submitted to the Register for review.

The documentation submitted for review is generally to be submitted in three copies according to the lists given in 4.1.2 to 4.1.13 with due regard to the specific features of the ship's type.

4.1.2 General documents are to be submitted in the following scope:

.1 ship's specification;

.2 general arrangement plans;

.3 list of associated equipment and materials with indication of the basic technical data, manufacturer and approval by the Register or another body recognized by the Register.

4.1.3 Hull documentation:

.1 determination of scantlings of hull members, including overall and local strength calculations, if required by the Rules;

.2 midship section with the most typical structural transverse sections and main framing members where scantlings of all main hull members, including superstructures and deckhouses, their material with steel grades and marks, spacing of main framing members, main particulars of the ship and their ratios are to be indicated;

.3 constructional profile;

.4 deck and platform structure;

.5 bottom and double bottom plans;

.6 shell expansion;

.7 longitudinal and transverse bulkheads;

.8 aft end framing and sternframe;

.9 fore end framing, stem and pushing bitts;

.10 propeller brackets and bossings as well as fixed nozzle rudders;

.11 drawings of main machinery seatings;

.12 tanks outside double bottom being an integral part of the hull with indication of the height of overflow and air pipes;

.13 subdivision of hull into sections with brief description of hull construction and welding process;

.14 hull welding table containing the following information:

.14.1 name and thickness of structural components to be joined;

.14.2 shape or symbol of edge preparation;

.14.3 marks and grades of base metal;

.14.4 marks and grades of welding consumables;

.14.5 methods of welding and position of the joint.

If the information indicated in 4.1.3.14.1 to 4.1.3.14.5 is given in full scope on the ship's hull drawings, the welding table may be omitted;

.15 hull tightness test scheme with a pressure head table.

4.1.4 Documentation on arrangements, equipment, outfit and signal means:

.1 arrangement plan of openings in hull, superstructures and deckhouses with indication of coaming heights and type of closing appliances;

.2 calculation of closing appliances;

.3 general arrangement of steering gear, anchor, mooring, towing, coupling and mast arrangements with main information on the arrangements equipment;

.4 calculations of steering gear, anchor, mooring, towing and coupling arrangements;

.5 general arrangement of life-saving appliances with the main information on equipment;

.6 general arrangement plan of signal means with indication of their characteristics.

4.1.5 Documentation on stability, subdivision and freeboard:

.1 lines drawing;

.2 hydrostatic curves;

.3 calculations and curves of arms of form stability (cross-curves) with schemes of hull volumes taken into account;

.4 calculations materials relating to verification of the ship's stability according to the Rules; mass tables for various load conditions with indication of distribution of cargoes, fuel oil, water and liquid ballast in tanks; calculation of windage area, heel caused by crowding of passengers, corrections for free surface effect of liquid cargoes, angles of flooding, etc.; deck cargo arrangement plan;

.5 summary table of stability verification results for different load conditions and static and dynamic stability curves;

.6 freeboard calculation and load line mark drawing;

.7 subdivision calculation and damaged stability verification in case of compartment flooding (for ships which subdivision is ensured).

4.1.6 Documentation on fire protection:

.1 arrangement plan of steel and fire-proof divisions with indication of doors, closures, passages, channels, etc. in divisions, escape routes and emergency exits;

.2 elementary diagrams of fire extinguishing systems, shipboard fire extinction stations and fire posts;

.3 fire detection and alarm systems;

.4 calculations of fire extinguishing systems;

.5 detailed description of the ship's fire protection with indication of heat insulation, finishing materials, constructional materials, places where they are fitted and their combustibility, calculation of the amount of combustible materials per 1 m^2 of the floor area of standard spaces;

.6 elementary diagrams and arrangement plan of liquefied-gas household units;

.7 list of fire-fighting outfit.

4.1.7 Documentation on machinery installations:

.1 general arrangement of machinery, boilers and equipment in machinery and boiler spaces and emergency sources of power spaces with indication of escape routes;

.2 diagrams and description of remote control for main machinery with information on equipment of remote control stations with control devices, indication and signalling devices, means of communication and other arrangements;

.3 general view of shafting;

.4 stern-tube and parts of stern-tube arrangement, including seals;

.5 propeller, intermediate and thrust shafts;

.6 journal and thrust bearings, their fastening;

.7 shaft connections and couplings;

.8 strength calculations of shafting;

.9 calculation of torsional vibrations for main machinery installations with internal combustion engines power output of more than 75 kW, for electric propulsion plants a necessity in torsional vibration calculation is subject to special consideration by the Register in each particular case;

.10 a fixed-pitch propeller drawing;

.11 strength calculation of propeller blade;

.12 drawings of controllable-pitch propeller and diagrams of controllable-pitch propeller systems, including diagrams of actuating mechanism of CPP and its description;

.13 calculations of propeller blade and of CPP pitch-actuating mechanism parts;

.14 documentation on active means of the ship's steering (AMSS);

.14.1 general arrangement plans with necessary sections and sealing details;

.14.2 drawings and calculations of propeller, shafts, couplings, pinions, gear wheels of steerable propellers, waterjets and thrusters;

.14.3 drawings of bearings and seals;

.14.4 diagrams of cooling, lubricating oil, hydraulic turning systems for steerable propellers (CPP blades);

.14.5 documentation on monitoring, control and protection systems.

14.1.8 Documentation on systems and piping:

.1 diagrams of bilge and ballast systems;

.2 diagrams of drain, sewage and scupper pipes with indication of watertight bulkheads, freeboard deck and distances from overboard discharges to that deck;

.3 diagram of fuel oil loading and transfer systems;

.4 diagram of sounding, air and overflow pipes with indication of filling pipes diameters;

.5 diagrams of cargo, stripping and gas vent systems on oil tankers;

.6 diagram of feed water and blowing-off systems for boilers;

.7 diagram of steam pipes and fuel oil, lubricating oil and liquid cargo heating systems;

.8 diagrams of fuel oil and lubricating oil systems;

.9 diagram of main and auxiliary machinery cooling systems;

.10 diagram of compressed air system;

.11 diagram of exhaust gas pipes;

.12 diagram of ventilation systems of accommodation, service, cargo and machinery spaces with indication of watertight bulkheads and fire-proof divisions, arrangement of fire dampers, closures of ventilation ducts and openings;

.13 diagram of hydraulic drives system;

.14 diagram of thermal fluid systems;

.15 arrangement and fastening drawing of bottom and side fittings, sea and ice chests;

.16 calculations of systems.

4.1.9 Documentation on electrical equipment:

.1 circuit diagrams of power generation and distribution from the main and emergency sources of electrical power: the ship's mains, lighting and navigation lights;

.2 circuit diagrams and general arrangement plan of main and emergency switchboards, control desks and other switchboards of non-standard design;

.3 calculation results of the power output of the ship's electric plastic plant required to provide all operating conditions, substantiation of the choice of the number and output of the generators as well as power output calculation for emergency sources of electrical power;

.4 calculation results of cable cross-section calculation with indication of their types, currents and protection;

.5 circuit or detailed diagrams of the main current, excitation, control, signalling, protection and interlocking of the electric propulsion plant;

.6 calculation results of the required output of propulsion generators to ensure normal operation under all operating conditions;

.7 calculation results of short-circuit currents;

.8 calculation results of voltage drops when a consumer with the highest starting power is started;

.9 calculation results of illumination intensity for spaces;

.10 circuit diagrams of external connections of the ship's steering equipment, telephone communication, general alarm system and fire alarm system;

.11 circuit diagrams of electric drive of steering gear, electric systems of remote control for rudder electric drive, protection and signalling;

.12 circuit diagrams of electric drives of anchor and mooring machinery, electric systems, remote control, protection and signalling;

.13 general arrangement plan of essential electrical equipment and electric propulsion plant;

.14 diagrams of lubrication systems for electric machines and air cooling systems for main electric machines.

4.1.10 Documentation on automation:

.1 list of systems, devices and elements of automation, their technical description with indication of the purpose, principle of operation, and information on the Register approval;

.2 circuit and block diagrams, diagrams of power supply, list of controlled parameters of alarm and warning systems;

.3 technical documentation on remote automated control of main machinery and CPP: block and circuit diagrams, diagrams of power supply, protection, signalling and parameter indication of main engines and CPP;

.4 circuit and block diagrams of automation systems of main engines (cooling, lubrication, fuel oil preparation systems, etc.) with indication of instrumentation, diagrams of power supply, protection, signalling and parameter indication;

.5 technical documentation on automation of auxiliary engines and electric generating station: circuit and block diagrams with indication of instrumentation, diagrams of power supply, protection, signalling and parameter indication of auxiliary engines and generators;

.6 technical documentation on automation of boiler installation: circuit and block diagrams with indication of instrumentation, diagrams of power supply, protection, signalling and parameter indication of boiler installations;

.7 circuit and block diagrams of automation of starting air compressors, diagrams of protection, signalling and indication;

.8 circuit and block diagrams of automation and remote control of bilge and ballast systems, power supply, signalling and indication;

.9 circuit and block diagrams of remote level sounding;

.10 drawings of front panels of desks and boards of control and alarm signalling systems at the main control station and on the navigating bridge.

4.1.11 Documentation on radio equipment:

.1 diagram of connections of radio equipment and commutation of aerials;

.2 arrangement plans (at least in two projections) of radio equipment and sources of electrical power as well as of heating, ventilation, communication, signalling and lighting in all spaces intended for installation of radio equipment;

.3 arrangement plans of aerials (plan and side view) with indication of spaces intended for installation of radio equipment;

.4 drawings and diagrams of radio equipment for lifeboats, if any;

.5 calculation of the range covered by VHF installations;

.6 capacity calculation of emergency source of electrical power (accumulator battery) for radio installations;

.7 list of radio equipment installed on board the ship with indication of its technical characteristics and information on radio equipment approval by the Register or by another authorized body;

.8 descriptions, circuit diagrams, drawings, photos and test records of the radio equipment not approved by the Register.

4.1.12 Documentation on navigational equipment:

.1 connection diagrams of navigational instruments;

.2 arrangement plans of navigational instruments and their sources of power as well as of heating, ventilation, communication, signalling and lighting systems in all spaces intended for installation of navigational equipment;

.3 list of navigational equipment installed on board the ship with indication of its technical characteristics and information on navigational equipment approval by the Register or by another authorized body.

4.1.13 Documentation on means for the prevention of pollution from ships:

.1 explanatory note of meeting the requirements of Part XIII "Means for the Prevention of Pollution from Ships" (if the Project Specification does not contain the information required);

.2 arrangement plan of equipment and arrangements for prevention of pollution from ships;

.3 calculation of the required capacity of holding tanks for oil residues, oil-containing bilge water, sewage and domestic waste water, as well as of the required capacity of garbage receptacles, and their general arrangement plan;

.4 diagrams of pipelines of systems for collecting, treatment, storage and discharge of oil-containing bilge water, oil residues, sewage and domestic waste water;

.5 diagrams of pipelines of systems for collecting, accumulating and discharge of oily mixtures from the cargo area of oil tankers.

4.1.14 Documentation on a ship fitness for the carriage of dangerous goods:

.1 design justification confirming compliance of the ship's structure, equipment and outfit and cargo spaces and/or open deck with the requirements for the carriage of dangerous goods by the European inland waterways;

.2 documents according to 1.3.3, Part XIV "Requirements for Ships Carrying Dangerous Goods".

4.2 TECHNICAL DOCUMENTATION OF A SHIP SUBJECT TO CONVERSION OR RECONSTRUCTION

4.2.1 During conversion or reconstruction of the ship classed with the Register, technical documentation relating to those parts of the hull, machinery, arrangements or equipment which are subject to conversion or reconstruction and, where necessary, updated general materials and documents on stability, freeboard and subdivision (damaged stability) are to be submitted to the Register for review and approval.

4.2.2 In case new machinery or arrangements are to be installed on the ship in service which differ substantially from those fitted initially and are to meet the requirements of the Rules, additional technical documentation of new installations is to be submitted to the Register for review and approval in connection with that machinery and arrangements within a scope required for the ship under construction (refer to 4.1).

4.3 WORKING DOCUMENTATION OF A SHIP UNDER CONSTRUCTION

4.3.1 General:

.1 lists of life-saving, fire extinguishing and other outfit required by the Rules with indication of main technical characteristics and position on board the ship;

.2 programmes of mooring tests and sea trials.

4.3.2 Hull documentation:

.1 stem and sternfame;

.2 sections and details of the main hull, superstructures and deckhouses, including decks, transverse and longitudinal bulkheads, sides, bottom, double bottom (with indication of manholes and openings), tanks outside the double bottom being the structural part of the hull, etc.;

.3 engine and boiler casings, coamings and other guards of openings in the hull, superstructures and deckhouses, escape trunk;

.4 propeller brackets and bossings, fixed nozzle rudders;

.5 seatings for main machinery, boilers and shafting bearings, seatings for auxiliaries, equipment and arrangements subject to the Register technical supervision;

.6 bulwark;

.7 hull watertightness test plan;

.8 weld control plan for hull and superstructures.

4.3.3 Documentation on arrangements and equipment:

.1 general arrangement, assemblies and parts of closing appliances of openings in hull, superstructures and deckhouses;

.2 general arrangement, assemblies and parts of steering gear, anchor, life-saving, towing, coupling arrangements, masts, guard rails, hold fittings.

4.3.4 Documentation on fire protection:

.1 assemblies and parts of fire-protection divisions, documents containing satisfactory results of the fire tests required;

.2 construction and calculations of separate assemblies and equipment of fire extinction and fire alarm systems.

4.3.5 Documentation on systems and piping:

.1 ship's systems drawings:

.1.1 bilge;

.1.2 ballast;

.1.3 air, sounding, overflow pipes;

.1.4 remote level sounding in fuel oil tanks;

.1.5 ventilation of accommodation, service, cargo and machinery spaces with construction of dampers and shut-off fittings for closing ventilating air supply and other openings to ensure fire safety of the ship;

.1.6 gas vent pipes with construction of flame arresters and breathing valves;

.1.7 sewage, drainage and scuppers;

.1.8 cargo and stripping;

.1.9 liquid cargo heating;

.1.10 fuel oil loading and transfer;

.1.11 hydraulic drives;

.2 drawings of propulsion plant piping:

.2.1 live and waste steam, blow-off steam lines, structural joints and connections of heating elements for fuel oil, water and lubricating oil heating;

.2.2 feed water and blow-off;

.2.3 fuel oil and lubricating oil;

.2.4 cooling;

.2.5 exhaust gas manifold and uptakes;

.2.6 compressed air;

.3 arrangement plan and details of attachment of bottom and side fittings;

.4 structural assemblies of pipe penetrations through watertight and fireproof bulkheads and decks.

4.3.6 Documentation on machinery and boiler installations:

.1 drawings of installation and attachment of main machinery and steam boilers;

.2 fuel oil and lubricating oil tanks fittings;

.3 drawings of silencers and spark arresters of exhaust gas pipes and uptakes.

4.3.7 Documentation on shafting and stern tube:

.1 drawings of thrust, intermediate and propeller shafts;

.2 drawings of main and thrust bearings and their attachment;

.3 drawings of couplings;

.4 stern tube and stern-tube parts (bushes, bearings, seals).

4.3.8 Documentation on propellers:

.1 drawing of fixed pitch propeller with fastenings of detachable blades (for propellers with detachable blades);

.2 controllable pitch propeller drawings:

.2.1 hub in assembly;

.2.2 blade;

.2.3 propeller shaft and its fastening to the hub;

.2.4 oil transfer block in assembly;

.2.5 pitch actuating mechanism in assembly;

.2.6 shaft of pitch actuating mechanism;

.3 drawings on active means of the ship's steering:

.3.1 documentation according to 4.3.7, 4.3.8.1, 4.3.8.2 (whichever is applicable);

.3.2 drawings in addition to those referred to in 4.3.8.3.1, depending on specific features of the active means of the ship's steering at the Register discretion.

4.3.9 Documentation on electrical equipment:

.1 structural assembly drawings (for non-standard items only) of the main and emergency switchboards of the ship's electric generation plant; switchboards and desks of electric propulsion plant; power and lighting switchboards;

.2 diagrams of non-standard drives of shipboard essential machinery;

.3 diagrams of outer connections and installation drawings of devices intended for measuring of non-electric values (pressure level, temperature, etc.);

.4 drawings and diagrams of electrical equipment, lightning protection devices, protection against electrical interference earthing;

.5 arrangement plans of electrical equipment and cable installation;

.6 list of spare parts.

4.3.10 Documentation on radio equipment:

.1 wiring diagram of radio equipment with indication of types and cross-sectional areas of cables as well as protective means against radio interference;

.2 diagrams of power supply to radio equipment from the ship's sources of electrical power and means of electrical protection;

.3 cable installation drawings with indication of cable penetrations through watertight, gastight and fireproof bulkheads and decks;

.4 drawing of arrangement and fastening of radio equipment and sources of power;

.5 drawing of aerials fastenings and constructions of aerial leads-in and their guards;

.6 structural drawing of earthing devices.

4.3.11 Documentation on navigational equipment:

.1 wiring diagram of navigational instruments with indication of types and cross-sectional areas of cables as well as protective means against radio interference;

.2 diagram of power supply to navigational instruments from the ship's sources of electrical power and means of electrical protection;

.3 drawing of arrangement and fastening of navigational instruments and sources of power;

.4 cable installation drawings with indication of cable penetrations through watertight, gastight and fireproof bulkheads and decks;

.5 structural drawing of earthing devices.

4.3.12 Documentation on automation systems:

.1 mounting and structural drawings of blocks of automation systems, sensors, alarm devices, instruments as well of switchboards and desks of control and monitoring.

4.3.13 Documentation on means for the prevention of pollution from ships:

.1 drawings of systems for collecting, treatment, storage and discharge of oil-containing bilge water, oil residues, sewage and domestic waste water;

.2 drawing of the system for collecting, accumulating and discharge of oily mixtures from the cargo area of oil tankers;

.3 drawing of garbage receptacles securing to the ship’s structures.

APPENDIX (reference)

EUROPEAN INLAND WATERWAYS
List of community inland waterways divided geographically into Zones 1, 2, 3 and 4

Zone 1

Federal Republic of Germany:

Ems[1]	From a line linking the former Greetsiel lighthouse and the western pier of the port entrance at Eemshaven seawards as far as latitude 53°30′ N and longitude 6°45′ E, i.e. slightly seawards of the lightering area for dry-cargo carriers in the Alte Ems[2]
Notes: [1] Geographical names are given in accordance with the original – refer to Annex 1 to the Directive 2006/87/EC of the European Parliament and of the Council of 12 December 2006 establishing technical requirements for inland navigation ships and Appendix 1 to the Resolution No. 61 of the UN Economic Commission for Europe “Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels”. [2] In the case of ships whose home port is elsewhere, account is to be taken of Article 32 of the Ems-Dollart Treaty of 8 April 1960 (BGBL, 1963 II, p. 602).	

Republic of Poland:

The part of Pomorska Bay southward from the line linking NordPerd on Rugen Island and the lighthouse Niechorze.

The part of Gdańska Bay southward from the line linking the lighthouse Hel and the entrance to the port of Baltijsk.

Ukraine:

Dniprobuzkiy Lyman: up to the Port of Ochakiv.

Pivdenny Buh: downstream of Mykolaiv sea port.

Kakhovske Reservoir: from the dam of Kakhovska Hydro-electric Plant to Bilenka wharf (180 km).

Kremenchuzke Reservoir: from the dam of Kremenchuzka Hydro-electric Plant to the Topylivka village (70 km).

Zone 2

Czech Republic:
Dam Lake Lipno
Federal Republic of Germany:

Ems	From a line across the Ems near the entrance to the port of Papenburg between Diemen pumping station and the opening of the dyke at Halte as far as a line linking the former Greetsiel lighthouse and the western pier of the port entrance at Eemshaven
Jade	Inside a line linking the Schillig cross light and Langwarden church tower
Weser	From the north-western edge of the railway bridge in Bremen as far as a line linking Langwarden and Cappel church towers, including the Westergate, Rekumer Loch, Rechter Nebenarm and Schweiburg side branches
Elbe	From the lower limit of the port of Hamburg as far as a line linking the Döse beacon and the western edge of the Friedrichskoog dyke (Dicksand), including the Nebenelbe and the Este, Lühe, Schwinge, Oste, Pinnau, Krückau and Stör tributaries (in each case from the mouth to the barrage)
Meldorfer Bucht	Inside a line linking the western edge of the Friedrichskoog dyke (Dicksand) and the western pier head at Büsum
Eider	From the Gieselau Canal to the Eider barrage
Flensburger Förde	Inside a line linking Kegnäs lighthouse and Birknack
Schlei	Inside a line between the Schleimünde pier heads
Eckernförder Bucht	Inside a line linking Boknis-Eck and the north-eastern point of the mainland near Dänisch Nienhof
Kieler Förde	Inside a line linking the Bülk lighthouse and the Laboe naval memorial
Nord-Ostsee-Kanal (Kiel Canal)	Inside a line linking the pier heads at Brunsbüttel as far as a line linking the entry lights at Kiel-Holtenau, including Obereidersee and Enge, Audorfer See, Borgstedter See and Enge, Schirnauer See, Flemhuder See and the Achterwehrer Canal
Trave	From the north-western edge of the railway lift bridge and the northern edge of the Holstenbrücke (Stadttrave) in Lübeck as far as a line linking the southern inner and northern outer pier heads at Travemünde, including the Pötenitzer Wiek, Dassower See and the Altarmen at Teerhof island
Leda	From the entrance of the outer harbour of Leer sea lock to the mouth
Hunte	From the port of Oldenburg and from 140 m downstream of the Amalienbrücke in Oldenburg to the mouth
Lesum	From the Bremen-Burg railway bridge to the mouth
Este	From the tail water of Buxtehude lock to the Este barrage
Lühe	From the tail water of the Au-Mühle in Horneburg to the Lühe barrage
Schwinge	From the Salztor lock in Stade to the Schwinge barrage
Oste	From the north-eastern edge of the Bremervörde mill dam to the Oste barrage
Pinnau	From the south-western edge of the railway bridge in Pinneberg to the Pinnau barrage
Krückau	From the south-western edge of the bridge leading to/from the Wedenkamp in Elsmhorn to the Krückau barrage

Stör	From Rensing tide gauge to the Stör barrage
Freiburger Hafenpriel	From the eastern edge of the sluice in Freiburg an der Elbe as far as the mouth
Wismarbucht, Kirchsee, Breitling, Salzhaff and Wismar port area	Seawards as far as a line between Hoher Wieschendorf Huk and Timmendorf light and a line linking Gollwitz light on the island of Poel and the southern point of the Wustrow peninsula
Warnow, including the Breitling and side branches	Downstream of the Mühlendamm from the northern edge of the Geinitzbrücke in Rostock towards the sea as far as a line linking the northern points of the western and eastern piers in Warnemünde
Waters enclosed by the mainland and the Darss and Zingst peninsulas and the islands of Hiddensee and Rügen (including Stralsund port area)	Extending seawards between: the Zingst peninsula and the island of Bock: as far as latitude 54°26'42" N the islands of Bock and Hiddensee: as far as a line linking the northern point of the island of Bock and the southern point of the island of Hiddensee the island of Hiddensee and the island of Rügen (Bug): as far as a line linking the south-eastern point of Neubessin and Buger Haken
Greifswalder Bodden and Greifswald port area, including the Ryck	Seawards as far as a line from the eastern point of Thiessower Haken (Südperd) to the eastern point of the island of Ruden and continuing to the northern point of the island of Usedom (54°10′37″ N, 13°47′51″ E)
Waters enclosed by the mainland and the island of Usedom (the Pennestrom, including Wolgast port area and Achterwasser, and the Stettiner Haff)	Eastwards as far as the border with the Republic of Poland in the Stettiner Haff
Note. In the case of ships whose home port is in another state, account is to be taken of Article 32 of the Ems-Dollart Treaty of 8 April 1960 (BGBL, 1963 II, p. 602).	

French Republic:

Dordogne	Downstream from the stone bridge at Libourne
Garonne и Gironde	Downstream from the stone bridge at Bordeaux
Loire	Downstream from the Haudaudine bridge on the Madeleine arm and downstream from the Pirmil bridge on the Pirmil arm
Rhône	Downstream of the Trinquetaille bridge in Arles and beyond towards Marseille
Seine	Downstream of the Jeanne-d’Arc bridge in Rouen

Republic of Hungary:
Lake Balaton
Kingdom of the Netherlands:
Dollard
Eems
Waddenzee: including the links with the North Sea
Ijsselmeer: including the Markermeer and Ijmeer but excluding Gouwzee
Nieuwe Waterweg and the Scheur
Calland Kanaal west from the Benelux harbour
Hollands Diep
Breeddiep, Beerkanaal and its connected harbours
Haringvliet and Vuile Gat: including the waterways between Goeree-Overflakkee on the one hand and Voorne-Putten and Hoeksche Waard on the other
Hellegat
Volkerak
Krammer
Grevelingenmeer and Brouwerschavensche Gat: including all the waterways between Schouwen-Duiveland and Goeree-Overflakkee
Keten, Mastgat, Zijpe, Krabbenkreek, Eastern Scheldt and Roompot: including the waterways between Walcheren, Noord-Beveland and Zuid-Beveland on the one hand and Schouwen-Duiveland and Tholen on the other hand, excluding the Scheldt-Rhine Canal
Scheldt and Western Scheldt and its mouth on the sea: including the waterways between Zeeland Flanders, on the one hand, and Walcheren and Zuid-Beveland, on the other, excluding the Scheldt-Rhine Canal
Republic of Poland:
Lagoon of Szczecin
Lagoon of Kamień
Lagoon of Wisła
Bay of Puck
Wloclawski Reservoir
Lake Śniardwy
Lake Niegocin
Lake Mamry
Republic of Moldova:
Dubossarskoe Reservoir
Koshteshtskoe Reservoir
Ukraine:
Dnipro: downstream of the Port of Kyiv (with the exception of areas belonging to zone 1) and the section from the wharf Teremtsy to the dam of Kyiv Hydro-electric Plant
Pripyat: downstream of Vydoumka wharf
Pivdenny Buh: from Ternovate village to Mykolaiv sea port
Dnistrovskiy Lyman
Dnistrovske Reservoir: from the dam to Dnistrovka village (60 km)
Kakhovske Reservior: upstream of the Bilenka wharf (180 km)
Dniprovske Reservoir
Kremenchuzke Reservoir: upstream of Topylivka village (70 km)
Dniprodzerzhynske Reservoir
Kanivske Reservoir: from the dam of Kanivska Hydro-electric Plant to Novo-Ukrainka wharf
Kyivske Reservoir: from the dam of Kyivska Hydro-electric Plant to Teremtsy wharf on the Dnipro and to Vydumka wharf on the Pripyat
Pechenezke Reservoir
Krasnooskolske Reservoir
Burshtynske Reservoir
Svitiaz Lake

Zone 3

Kingdom of Belgium:
Maritime Scheldt (downstream of Antwerp open anchorage)
Czech Republic:
Labe: from the lock Ústí nad Labem-Střekov to the lock Lovosice
Dam Lakes: Baška, Brněnská (Kníničky), Horka (Stráž pod Ralskem), Hracholusky, Jesenice, Nechranice, Olešná, Orlík, Pastviny, Plumov, Rozkoš, Seč, Skalka, Slapy, Těrlicko, Žermanice
Lake Máchovo
Water Area Velké Žernoseky
Ponds: Oleksovice, Svět, Velké Dářko
Mining Gravel Lakes: Dolní Benešov, Ostrožná Nová Ves a Tovačov
Federal Republic of Germany:

Danube	From Kelheim (km 412,72) to the German-Austrian border
Rhine	From the German-Swiss border to the German-Netherlands border
Elbe	From the mouth of the Elbe-Seiten canal to the lower limit of the port of Hamburg
Müritz	

French Republic:
Rhine
Republic of Hungary:
Danube: from rkm 1812 to rkm 1433
Danube Moson: from rkm 14 to rkm 0
Danube Szentendre: from rkm 32 to rkm 0
Danube Ráckeve: from rkm 58 to rkm 0
River Tisza: from rkm 685 to rkm 160
River Dráva: from rkm 198 to rkm 70
River Bodrog: from rkm 51 to rkm 0
River Kettős-Körös: from rkm 23 to rkm 0
River Harmas-Körös: from rkm 91 to rkm 0
Channel Sió: from rkm 23 to rkm 0
Lake Velence
Lake Fertő
Kingdom of the Netherlands:
Rhine
Sneekermeer, Koevordermeer, Heegermeer, Fluessen, Slotermeer, Tjeukemeer, Beulakkerwijde, Belterwijde, Ramsdiep, Ketelmeer, Zwartemeer, Veluwemeer, Eemmeer, Alkmaardermeer, Gouwzee, Buiten Ij afgesloten Ij Nordzeekanaal, port of Ijmuiden, Rotterdam port area, Nieuwe Maas, Noord, Oude Maas, Beneden Merwede, Nieuwe Merwede, Dordsche Kil, Boven Merwede, Waal, Bijlandsch Canal, Boven Rijn, Pannersdensch Canal, Geldersche Ijssel, Neder Rijn, Lek, Amsterdam-Rhine-Canal, Veerse Meer, Schelde-Rhine-Canal as far as the mouth in the Volkerak, Amer, Bergsche Maas, the Meuse below Venlo, Gooimeer, Europort, Calandkanaal (east from the Benelux harbour), Hartelkanaal
Republic of Austria:
Danube: from the border with Germany to the border with Slovakia
Inn: from the mouth to the Passau-Ingling Power Station
Traun: from the mouth to km 1,80
Enns: from the mouth to km 2,70
March: to km 6,00

Republic of Poland:

River Biebrza from the estuary of the Augustowski Channel to the estuary of the river Narwia

River Brda from the link with the Bydgoski Channel in Bydgoszcz to the estuary of the river Wisła

River Bug from the estuary of the river Muchawiec to the estuary of the river Narwia

Lake Dabie to the frontier with internal sea waters

The Augustowski Channel from the link with the river Biebrza to the State border, together with the lakes located along the route of this Channel

The Bartnicki Channel from Lake Ruda Woda to Lake Bartężek, together with Lake Bartężek

The Bydgoski Channel

The Elbląski Channel from Lake Druzno to Lake Jeziorak and Lake Szeląg Wielki, together with these lakes and the lakes on the route of the Channel, and a byway in the direction of Zalewo from Lake Jeziorak to Lake Ewingi, inclusive

The Gliwicki Channel together with the Channel Kędzierzyński

The Jagielloński Channel from the link with the river Elbląg to the river Nogat

The Łączański Channel

The Ślesiński Channel and the lakes located along the route of this Channel and Lake Gopło

The Żerański Channel

River Martwa Wisła from the river Wisła in Przegalina to the frontier with internal sea waters

River Narew from the estuary of the river Biebrza to the estuary of river Wisła, together with Lake Zegrzyński

River Nogat from the river Wisła to the estuary of the Lagoon of Wisła

River Noteć (upper) from Lake Gopło to the link with the Górnonotecki Channel and the Górnonotecki Channel and River Noteć (lower) from the link of the Bydgoski Channel to the estuary to River Wisła

River Nysa Łużycka from Gubin to the estuary to River Odra

River Odra from the town of Racibórz to the link with River Eastern Odra which turns into River Regalica from the Klucz-Ustovo Piercing, together with that river and its side-branches to Lake Dąbie as well as a byway of River Odra from the Opatowice lock to the lock in Wrocław city

River Western Odra from a weir in Widuchowa (704.1 km of River Odra) to a border with internal sea waters, together with side-branches as well as the Klucz-Ustovo Piercing linking River Eastern Odra and River Western Odra

River Parnica and the Parnicki Piercing from River Western Odra to a border with internal sea waters

River Pisa from Lake Roś to the estuary of River Narew

River Szkarpawa from River Wisła to the estuary of the Lagoon of Wisła

River Warta from the Ślesińskie Lake to the estuary of River Odra

System of Wielkie Jeziora Mazurskie encompassing the lakes linked by the rivers and channels constituting a main route from Lake Roś (inclusive) in Pisz to the Wegorzewski Channel (including that channel) in Węgorzewo, together with Lakes Seksty, Mikołajskie, Talty, Tałtowisko, Kotek, Szymon, Szymoneckie, Jagodne, Boczne, Taty, Kisajno, Dargin, Łabap, Kirsajty and Święcajty, together with the Giżycki Channel and the Niegociński Channel and the Piękna Góra Channel, and a byway of Lake Ryńskie (inclusive) in Ryn to Lake Nidzkie (up to 3 km, constituting a border with the "Lake Nidzkie" nature reserve), together with Lakes Bełdany, Guzianka Mała and Guzianka Wielka.

River Wisła from the estuary of river Przemsza to the link with the Łączański Channel as well as from the estuary of that Channel in Skawina to the estuary of River Wisła to the Bay of Gdańsk, excluding the Włocławski Reservoir

Slovak Republic:

Danube: from Devín (rkm 1880,26) to the Slovak-Hungarian border

Belarus:

Dnepr: from the mouth of the Leshch river to the Lyubech wharf

Neman: from Mosta to the frontier with Lithuania

Pripyat: from the Stakhovo lock to the frontier with the Ukraine

Zapadnaja Dvina: from the mouth of the Usvyacha river to V. Dvinsk

Sozh: from Grodno to the mouth

Berezina: from Borisov to the mouth

Dneprovsko-Bugskiy Kanal: from Brest to the Stakhovo lock

Mikashevicheskiy Kanal: from Mikashevichi to the Pripyat river

Bulgaria:

Danube

Republic of Moldova:

Dnestr

Prut: from Koshteshtskaia hydroelectric power station to the mouth

Romania:
Danube
Serbia:
Danube
Ukraine:
Dnipro: upstream of Teremtsy wharf and the section from the Port of Kyiv to the dam of Kyiv Hydro-electric Plant and the Stariy Dnipro Arm (beyond the Khortytsa Lake)
Pripyat: from the mouth to the Belarus/Ukraine frontier
Desna and other tributaries of the Dnipro
Pivdenny Buh: upstream of Ternovate village
Dnister: upstream of Dnistrovka village
Danube
Ladyzhynske Reservoir
Dnistrovske Reservoir: from Dnistrovka village (60 km from the dam) to Vylkhovtsy village (190 km from the dam)
Other inland waterways not mentioned as belonging to zones 1 and 2
Croatia:
Danube
Switzerland:
Rhine: from Rheinsfelden to Niffer (Kembs)

Zone 4

Kingdom of Belgium:
The entire Belgian network except the waterways in Zone 3
Czech Republic:
All other waterways not listed in Zones 1, 2 and 3
Federal Republic of Germany:
All inland waterways other than those in Zones 1, 2 and 3
French Republic:
The entire French network except the waterways in Zones 1, 2 and 3
Italian Republic:
All national shipping waterways
Republic of Lithuania:
The entire Lithuanian network
Grand Duchy of Luxembourg:
Moselle
Republic of Hungary:
All other waterways not listed in Zones 2 and 3
Kingdom of the Netherlands:
All other rivers, canals and inland seas not listed in Zones 1, 2 and 3
Republic of Austria:
Thaya: up to Bernhardsthal
March: above km 6,00
Republic of Poland:
All other waterways not listed in Zones 1, 2 and 3
Slovak Republic:
All other waterways not listed in Zone 3

PART II. HULL

1 DESIGN PRINCIPLES

1.1 GENERAL

1.1.1 Definitions and explanations.

The definitions and explanations relating to general terminology of the Rules are given in Part I "Classification".

For the purpose of the present Part of the Rules the following definitions have been adopted.

1.1.1.1 Main dimensions, draught.

Load waterline is the waterline in the plane of the maximum draught allowed for the ship's position without heel and trim.

Moulded depth D is the vertical distance measured amidships from the top of the plate keel or from the point of abutment of the inner surface of the shell plating to the bar keel, to the top of the upper deck beam at side. On ships having a rounded gunwale, the depth is measured to the point of intersection of the moulded lines of the upper deck and side, the lines extending so as if the gunwale were of angular design.

Length of ship L is the distance measured in the plane of the load waterline between the points of intersection of its fore and aft parts with the central plane.

Where the fore or aft end is of an unusual form, the length L is subject to special consideration by the Register.

Draught d is the vertical distance measured amidships from the top of the plate keel or from the point of abutment of the inner surface of the shell plating to the bar keel, to the load waterline.

Moulded breadth B is the maximum breadth of the ship measured amidships to the moulded line of the frame.

Breadth of waterline B_{WL} is the breadth of the hull in m, measured from the outside of the side plating at the maximum draught line.

1.1.1.2 Decks.

Lower decks are the decks located below the upper deck.

Upper deck is the uppermost continuous deck over the entire length of the ship.

Superstructure deck is the deck bounding the superstructure tire from above.

Strength deck is the deck forming the upper flange of the hull girder. The uppermost continuous deck of the ship's hull or the deck of a strength midship superstructure may be considered as the strength deck.

Deckhouse top is the deck bounding the deckhouse tier from above.

Platform is the lower deck extending over the part of the ship's length or breadth only.

1.1.1.3 Structures.

Superstructure is a decked structure on the upper deck extending from side to side of the ship or located at a distance of not more than 4 per cent of the ship's breadth B from any side of the ship.

Deckhouse is a decked structure on the upper deck or superstructure deck located at a distance of more than 4 per cent of the ship's breadth from at least one of the ship's sides.

1.1.1.4 Sections of the ship's length and ship's spaces.

Safe area is the area which is externally bounded by a vertical surface running at a distance of $1/5B_{WL}$ parallel to the course of the hull in the line of maximum draught.

Independent cargo tank is a tank permanently attached to the ship not being part of the ship's structure.

Integral cargo tank is a tank permanently attached to the ship being part of the ship's structure.

Cargo pump room is a service space where the cargo pumps and stripping pumps are installed together with their operational equipment.

Cargo area is a space of the tanker between two vertical planes perpendicular to the ship's centerline, which comprises cargo tanks, hold spaces, cofferdams, double-hull spaces and double bottoms; these planes normally coincide with the cofferdam bulkheads or end bulkheads of cargo tanks. Their intersection line with the deck is referred to as the boundary of the cargo area part below deck. For a trunk ship or a ship with independent cargo tanks, the deck is in line with the deck of cargo tanks.

Cargo tank is a tank attached to the tanker, the boundaries of which are either formed by the ship's hull itself or by the walls separate from the hull, and which is intended for the carriage of cargoes in bulk.

Cofferdam is an athwartship compartment, which is bounded by watertight bulkheads and which may be inspected. The cofferdam extends over the whole area of the end bulkheads of the cargo tanks. The bulkhead not facing the cargo area extends from one side of the ship to the other and from the bottom to the deck in one frame plane.

Engine room aft means that the mid-length of the engine room is beyond $0{,}3L$ aft of amidships.

Midship section is the cross-section of the ship's hull at the middle of the ship's length L.

Fore and aft perpendiculars are vertical lines in the central plane bounding the length L from bow and stern.

S h i p ' s e n d s are sections of the ship's length $0{,}15L$ each from the fore and aft perpendiculars.

T r a n s i t i o n a l r e g i o n s are sections of the ship's length between the midship and the ship's ends.

S h i p ' s p e a k s are end compartments of the ship, i.e. the forepeak and afterpeak separated from other compartments of the ship by watertight bulkheads.

S e r v i c e s p a c e is a space, which is accessible during the operation of the ship and which is neither part of the accommodation nor of the cargo tanks, with the exception of the forepeak and after peak, provided no machinery has been installed in the latter spaces.

M i d s h i p r e g i o n is the part of the ship's length close to amidships, equal to $0{,}5L$ ($0{,}25L$ forward and aft from amidships) unless otherwise specified in the text.

H o l d is a part of the ship which, whether covered by hatchway covers or not, is bounded fore and aft by bulkheads and which is intended to carry goods in packages or in bulk. The upper boundary of the hold is the upper edge of the hatchway coaming. Cargo extending above the hatchway coaming is to be considered as loaded on deck.

H o l d s p a c e is an enclosed part of the ship, which is bounded fore and aft by watertight bulkheads and which is intended only to carry cargo tanks independent of the ship's hull.

P r e s s u r e t a n k is a tank designated and approved for a working pressure $\geqslant 400$ kPa.

1.1.1.5 Characteristics of the ship's hull framing and structures.

P l a t e s t r u c t u r e s are sections of plating or flooring bounded by stiffening members. Plate structures include sections of the deck, platform and inner bottom plating, and sections of the bottom, sides, bulkheads plating, as well as webs of deep members.

F r a m i n g means primary members and deep members stiffening plate structures. Deep members give support to primary members. Primary members include the longitudinals of decks, sides, longitudinal bulkheads, inner bottom plating and bottom, stiffeners and horizontal beams of bulkheads, shell and bottom frames, beams, bottom and reverse frames of bracket floors, etc. Deep members include deep beams, carlings, web frames, side stringers, floors, bottom stringers, the vertical keel, vertical webs and horizontal girders of bulkheads, etc.

T i g h t s t r u c t u r e is a structure impervious to water and other liquids.

M a i n f r a m e s are vertical members of side framing fitted in the plane of floors or bilge brackets one spacing apart.

I n t e r m e d i a t e f r a m e s are additional frames fitted between main frames.

S p a c i n g a is a distance between primary members, in m.

S p a c i n g o f d e e p m e m b e r s a_d is a distance between neighbouring (adjacent) deep members, in m.

The scantlings of primary and deep members are based on the required section modulus, moment of inertia, web sectional area, thicknesses of the web and face plate, as well as the width of the last.

Geometric properties of the member section, unless provided otherwise, are determined taking into consideration the effective flange.

If the member is so arranged that it is not normal to the effective flange, the section modulus is to be increased in proportion to $1/\cos\alpha$, where α is the angle, in degrees, between the member web and the perpendicular to the plating (flooring) at the section considered. If $\alpha \leqslant 15°$, no increase of the section modulus is required.

Rounding-off of the required scantlings of structural members, excepting a thickness, is generally to be made in the direction of increase. The plate thickness as required by the Rules is to be rounded off to the nearest 0,5 or integer of millimeters.

The values of negative rolling tolerances for plates are to comply with 3.2.7, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

The span length l of a primary and deep member is measured along the member face plate as the distance between its span points. Unless provided otherwise, where end brackets are fitted, the span points are to be taken at the mid-length of the bracket. In this case the span point position is to be such that the height of the end bracket does not exceed the web depth of the member considered (Fig. 1.1.1.5). For a curvilinear member the span length is assumed equal to the length of the chord connecting its span points.

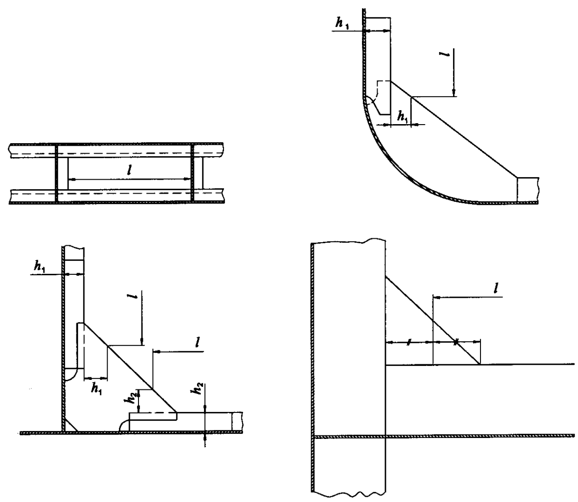


Fig. 1.1.1.5

The thickness of the effective flange is assumed equal to its mean thickness in the member section under consideration.

The width of the effective flange a_f, in m, of primary members is determined by the following formulae:

$a_f = l/6$;
(1.1.1.5-1)
$a_f = 0{,}5(a_1 + a_2)$

where a_1, a_2 = distance from the member in question to the nearest members of the same direction located on both sides of the above member, in m,

whichever is less.

The width of the effective flange c_f, in m, of deep members is determined by the following formula:

$$c_f = k_c \qquad (1.1.1.5\text{-}2)$$

where $c = 0{,}5(c_1 + c_2)$ (1.1.1.5-3)
where c_1, c_2 = distance from the deep member in question to the nearest deep members of the same direction located on both sides of the above member, in m;
k = factor according to Table 1.1.1.5 depending on a value of c, a reduced span l_r and the number n of members supported by the deep member in question.

Table 1.1.1.5

Number of members, n	k values at l_r/c						
	1	2	3	4	5	6	7 and over
$\geqslant 6$	0,38	0,62	0,79	0,88	0,94	0,98	1
$\leqslant 3$	0,21	0,4	0,53	0,64	0,72	0,78	0,8

Note. For intermediate values of l_r/c and n, the factor k is determined by linear interpolation.

The reduced span length for deep members is determined by the following formulae:

for simply supported members

$$l_r = l; \qquad (1.1.1.5\text{-}4)$$

for fixed members

$$l_r = 0{,}6l. \qquad (1.1.1.5\text{-}5)$$

The type of member end supports (fully-fixed, simple) is determined proceeding from general engineering principles with due regard for an actual structural design (presence of brackets, webs and face plates welding, etc.) and is characterized by presence or absence of a bending moment in the span point of the member.

The width of the effective flange of cargo hatch comings is assumed equal to 1/12 of their span, but not more than half the distance between the cargo hatch and the ship's side for a hatch-side coaming, and half the distance between the cargo hatch and transverse bulkhead (or the beam nearest to the cargo hatch) for a hatch-end coaming.

The width of the effective flange of deep members situated normally to the corrugations directions is to be assumed equal to 15s and 20s for trapezoidal and wave-shaped corrugations, respectively (s = thickness of corrugated plates of plating or flooring, in mm) or 0,1c (c is determined by the Formula (1.1.1.5-3)), in mm, whichever is less.

Where primary members parallel to deep members are fitted across the width of the effective flange of the latter, full cross-sectional areas of the above primary members are to be taken into account when determining the inertia moment and section modulus of deep members.

Determination of the section modulus and inertia moment of deep members is subject to special consideration by the Register if the area of an effective flange is less than that of the face plate. This applies to deep members of corrugated structures.

1.1.2 Application.

1.1.2.1 The requirements of the present Part apply to steel inland navigation ships of welded construction of the following types:

.1 self-propelled and non-self-propelled dry cargo ships (towed and pushed);

.2 self-propelled and non-self-propelled tankers (towed and pushed);

.3 displacement passenger ships;

.4 tugs and pushers;

.5 cargo push-ships;

.6 industrial ships of all types.

On self-propelled dry cargo ships and tankers (including combination carriers) the engine room is assumed to be located aft, and in other ships, amidships.

1.1.2.2 For cargo ships over 80 m in length, passenger ships over 60 min length, tugs powered at over 1200 kW, pushers powered at over 2200 kW and industrial ships over 60 m in length, and also for the listed and other types of ships having the main dimensions proportion L/D>32 or L/B>10, the checking calculation of hull elements specified according to the present Part is to be done. Strength is to be checked according to the procedure approved by the Register.

1.1.2.3 In order to design the optimal structure of the ship's hull, the thicknesses and scantlings of hull members may be reduced on agreement with the Register. Irrespective of the main dimensions and the purpose of such a ship, the strength calculation is compulsory. The check of strength is to be performed according to the procedure approved by the Register.

1.1.2.4 Scantlings of hull members of longitudinal and transverse framing, bottom and deck plating of dry cargo ships and tankers are determined in the Rules depending on the ship's loading sequence.

1.1.2.4.1 The following dry cargo ships loading sequences are taken into account:

.1 the ship's loading in one pass from one ship's end to the other for the full load-carrying capacity so that the amount of the cargo being loaded always complies with the length of the hold being filled. The loading sequence designated thereafter as "A";

.2 the ship's loading in two passes from one ship's end to the other and back for the full load-carrying capacity so that about half a cargo is loaded in the first pass, and the rest is in the second one. The loading sequence is designated thereafter as "B".

The requirements given in the subsequent sections, if the loading sequence is not specified, correspond to the method "A".

It is assumed that self-propelled ships are loaded starting from the stern and unloaded from the bow. Non-self-propelled ships may be loaded in any direction.

1.1.2.4.2 On non-self-propelled ships loaded in three or more passes or uniformly over the entire holds area scantlings of hull components may be reduced on agreement with the Register.

1.1.2.4.3 Cargoes in dry cargo ships may bestowed as a solid stack, separate "hills" or lots of goods. Where the local loading of a hold from separate "hills" or lots of goods exceeds more than by 33 per cent the loading from a cargo uniformly distributed over the entire hold surface, the ship's longitudinal and local strength calculations are to be submitted to the Register. The check of strength is to be carried out according to the procedure approved by the Register.

1.1.2.5 In order to ensure the strength of the ship in service, every dry cargo ship and tanker is to be provided with the Loading Manual regulating the procedure of loading/unloading performance including:

.1 the ship's loading conditions allowable for its operation, partial loading inclusive;

.2 type loading sequences from the start of loading till taking over of a full load in one, two or more passes;

.3 conditions of the ship's tying-up for loading (ballast mass and arrangement, a possibility of simultaneous performance of cargo and ballast operations);

.4 allowable irregularity of loading both in the ship's length and breadth;

.5 recommended methods of cargo stowage, arrangement and securing, methods of control over cargo arrangement and quantity including bulk cargoes and grain subjected to shifting;

.6 direct instructions on the use of grabs, bulldozers and other means of cargo operations mechanization if taken into account in the ship's hull design;

.7 loading procedure, permissible capacity of cargo systems, permissible differentials of a cargo level in adjacent tanks, cargo level control methods, etc. are additionally to be specified for tankers.

1.1.3 Scope of technical supervision.

1.1.3.1 All the structures regulated by the present Part are subject to the Register technical supervision. For this purpose an access for their survey is to be provided.

1.1.3.2 While manufactured, the structures regulated by the present Part are subject to technical supervision for compliance with the requirements of Part XIII "Materials" and Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships and for compliance with the approved technical documentation specified in Part I "Classification" of the Rules.

1.1.3.3 Tightness tests of the ship's hull are to be carried out according to the provisions of Appendix 1, Part II "Hull" of Rules for the Classification and Construction of Sea-Going Ships.

1.2 MATERIALS

1.2.1 The requirements of the present Part on determination of hull structural members scantlings are valid if a carbon steel with yield stress 235 MPa meeting the requirements of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships is used.

The application of grade A steels for all hull structural members is allowed.

1.2.2 When structural members are made of a higher strength steel, the section modulus of beams may be reduced multiplying it by a factor η assumed according to Table 1.2.2.

Table 1.2.2

R_{eH}	235	315	355	390
η	1,0	0,78	0,72	0,68

1.3 GENERAL REQUIREMENTS FOR THE SHIP'S HULL STRUCTURE

1.3.1 General.

1.3.1.1 All changes in the shape or section of any member of welded hull structures are to be designed with a smooth transition. All openings are to have rounded corners and smooth edges.

1.3.1.2 The scantlings of sections and the thicknesses of plates used for longitudinal members are to change gradually along the hull.

Any change of a framing system and plating thicknesses adopted for the strength deck, bottom, sides and longitudinal bulkheads are not allowed in areas where mechanical properties of steel change.

1.3.1.3 A transition to a lesser depth of beam webs is to be effected within a length equal to at least twice the difference of the web depths; beam flanges are gradually to change from one into another.

1.3.1.4 Continuity of the largest possible number of main longitudinals and the gradual change of their cross-sections in way of their ends together with other arrangements contributing to the reduction of stress concentration are to be ensured.

1.3.1.5 The thickness difference for butting plates is not to exceed 0,3 of the thickness of a thicker plate or

3 mm whichever is less. With a larger difference the edge of a thicker plate is to be cut away. A scarf is to be made at a length of at least 5-fold difference of the plates thickness, $5\Delta s$, or in accordance with the standards recognized by the Register.

1.3.1.6 Separate framing members are to be arranged in one plane so that they form frames, e.g. carling-vertical web of a bulkhead-bottom stringer; deck longitudinal-bulkhead stiffener-bottom longitudinal; floor-frame-beam etc.

1.3.1.7 In the present Part the areas of intense vibration are:

.1 the ship's aft end:

lengthwise — up to the section forward of the aft edge of a propeller boss at a distance of at least three propeller diameters for single-screw ships and four diameters for two- and three-screw ships, but not less than up to the afterpeak bulkhead;

vertically — up to the nearest from the top continuous deck;

.2 engine room:

lengthwise — between the compartment bulkheads;

vertically — up to the nearest from the top continuous deck;

.3 locations of unstable (unbalanced) machinery.

1.3.1.8 Stiffeners and other structural members preventing the formation of hard spots in plating (flooring) at the edges of beam face plates and at the brackets toes are to be provided in tight structures, as well as in structures situated in the area of intense vibration.

1.3.1.9 The length of unsupported plating or flooring, i.e. the gap between the end of a beam supporting the plating and the nearest perpendicular web is to be not more than $4s$ or 60 mm, whichever is less (s — plate thickness, in mm). The requirements for the length of unsupported bottom and deck plating for a longitudinal framing system are given in 2.2.3.9 and 2.5.3.3.

1.3.1.10 In way of the ends of bulwark, bilge keels and other components welded to the hull, as well as generally of waterway bars, their height is gradually to decrease on a length of at least 1,5 times the height of these members. The ends of bulwark are to be tapered. The above is also recommended for the ends of the waterway.

1.3.2 Welding of stiffeners and longitudinals to their supports.

1.3.2.1 When a continuous stiffener passes through an opening in a support plate, its web is to be welded to the opening edge directly or through a connecting element, i.e. through a bracket, plank, etc. (refer to Fig. 1.3.2.1). The structural elements of openings, restraints and welds are to comply with the standards recognized by the Register. However, the minimum length of a weld therewith in way of the stiffener welding to the edge of a cutout is to be at least 0,5 of the continuous stiffener depth.

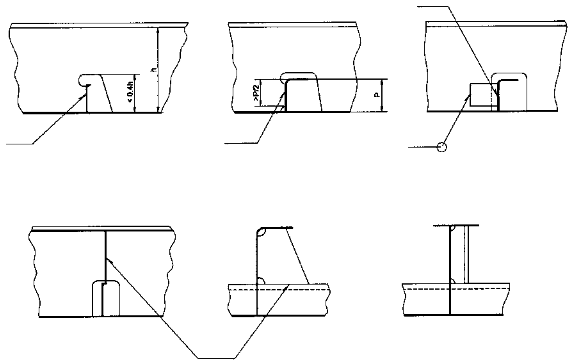


Fig. 1.3.2.1

1.3.2.2 The ends of stiffeners unsupported by brackets are to be cut at an angle of 30° (refer to Fig. 1.4.4.1).

1.3.2.3 Securing of longitudinals ends in way of their termination in transverse members is compulsory for any structure.

1.3.2.4 Where intercostal longitudinals are attached to transverse members with brackets, the web ends of the longitudinals being attached are recommended to treat according to Fig. 1.3.2.4 or to a similar unit. In this case, a distance between the extreme edge of an opening r and the bracket end is to be at least 1,5 times the beam depth.

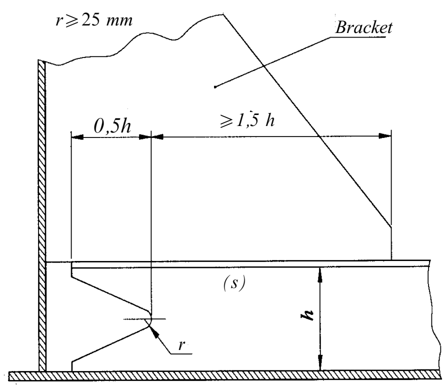


Fig. 1.3.2.4

1.3.3 Ends of deep longitudinals of the hull.

1.3.3.1 In way of bottom, side and deck deep longitudinals ends (carlings, bottom and side stringers, etc.) their depth is gradually to decrease at a length equal to 1,5 times the longitudinal web depth, and their ends are to be attached to transverse beams. If ended in a transverse bulkhead they are to be continued behind it as brackets within at least one spacing.

1.3.3.2 No more than 1/3 of bottom and deck longitudinals may simultaneously end in one hull cross-section. The transition from a longitudinal framing system to the transverse one is to be gradual within at least three spacings.

1.3.3.3 Longitudinals are not to end in places of large openings in the hull and in areas of stress concentration; they are to be continued behind those areas for a distance of at least three spacings.

1.3.3.4 In places where girders terminate their face plates and/or webs are to be scarfed depending on the unit design.

1.3.4 Connection of framing members.

1.3.4.1 In general, framing members are to have butt-welded joints.

1.3.4.2 Overlap joints may be allowed on agreement with the Register, except the areas of intense vibration, deep members connections and the areas subjected to concentrated loads.

1.3.4.3 Brackets are to be made of the material having as a rule the same yield stress as the material of the framing members connected.

1.3.4.4 Connection of framing members which webs are arranged in one plane (beam and frame, frame and floor, etc.) is to be made with brackets. Face plates of brackets are not to be welded to those of framing members.

1.3.4.5 Bracket scantlings are determined by the depth of the lesser section; when connecting framing members the brackets are to overlap the framing at a length of at least two depths of the lesser section, when connecting deep members – of at least one depth of the lesser section.

1.3.4.6 Brackets thickness is to be not less than that of the thinner web of members to be joined, or is to be 2,5 per cent of the length of a bearing edge for plain brackets and 2 per cent, for flanged brackets, whichever is greater.

1.3.4.7 The free edge of a bracket which length is over 45 bracket thicknesses is to be flanged. The flange width is to be at least $10s$ and not more than $15s$ (s = bracket thickness). The flange of a bracket is not to be brought to flanges (face plates) of stiffeners being joined (a gap is 2 to $3s$) and welded to them (refer to Fig. 1.3.4.7).

1.3.5 Design of framing members.

1.3.5.1 The web of a deep member is to be stiffened with a face plate welded or a flange bent back. The thickness of the face plate welded is to be not less than that of the member web and not to exceed the tripled thickness of the member web. The width of the flange bent back is not to exceed 12 times the member web thickness, and the width of a symmetric faced plate welded, 24 times the face plate thickness.

1.3.5.2 The scantlings of members, section moduli and inertia moments are regulated in the relevant chapters of the Rules. The following instructions therewith are to be observed:

.1 depth h of the member web is to be at least 1/30 of the member span;

.2 thickness s of the member web is to be at least $h/100 + 2$, in mm.

It is recommended that the thickness of the member web do not exceed that of plating or flooring supported by the member.

1.3.5.3 Webs of deep members with the web depth to the web thickness ratio over 80, as well as the webs over 500 mm deep weakened by openings are to be reinforced by stiffeners. Vertical stiffeners are to be fitted in the plane of at least each second member bearing against the deep member being stiffened, and, in any case, the distance between them is not to exceed the depth of the deep member web.

The stiffeners which are parallel to the face plate of a frame are to be fitted at a distance from one another, from the face plate of the frame or flooring (plating), not exceeding 65 thicknesses of the frame web.

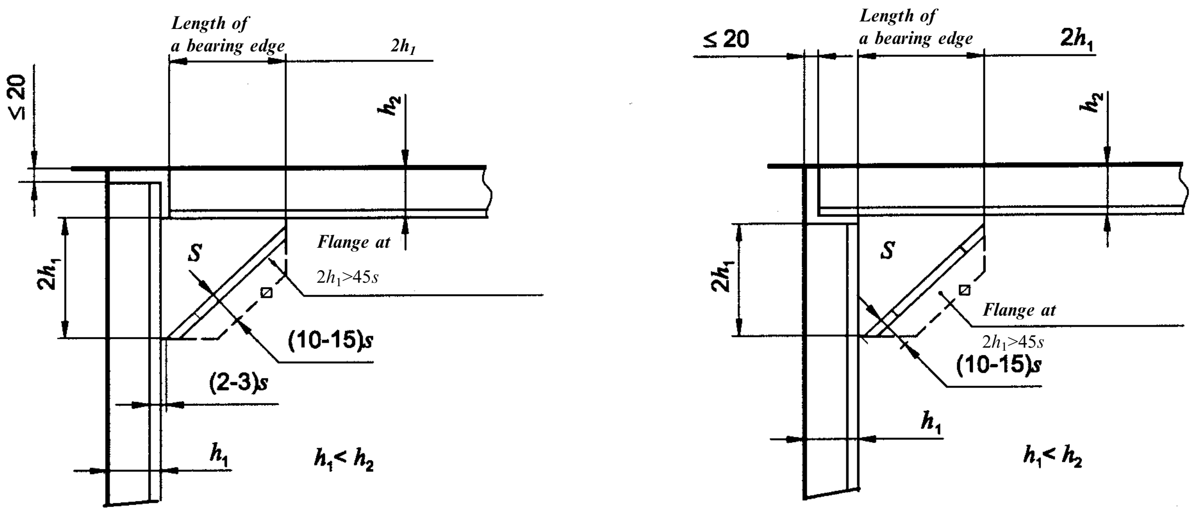


Fig. 1.3.4.7

1.3.5.4 The moment of inertia J, in cm^4, of vertical reinforcing stiffeners is to be not less than that determined by the following formula:

$$J = \gamma a s^3 10^{-3} \tag{1.3.5.4}$$

where s = thickness of the member web, in mm;
a = distance between stiffeners, in cm;
γ = factor according to Table 1.3.5.4 depending on the ratio of the member web depth h to the distance between stiffeners.

Table 1.3.5.4

h/a	1,0 and less	1,2	1,4	1,6	1,8	2,0	3,0	4,0
γ	0,3	0,6	1,3	2,0	2,9	4,0	8,3	17,6
Note. Intermediate values are obtained by linear interpolation.								

1.3.5.5 The moment of inertia J, in cm^4, of stiffeners parallel to the face plate of the frame is to be not less than that determined by the following formula:

$$J = 2{,}0 f l^2 \tag{1.3.5.5}$$

where f = area of the cross-section of a stiffener with an effective flange, in cm^2;
l = span of a stiffener, in m.

1.3.5.6 If members are considered to be freely supported at their ends, or they are subjected to an insignificant support moment only (e.g. a floor joined to a shell frame), bringing a face plate or flange to the end and its welding are not compulsory. The distance between the face plate or flange and the member being joined is to be equal to the twofold thickness of the flange or face plate.

For a restrained girder (e.g. a floor joined to a deep frame), the face plate or flange is to be welded across the entire width to the face plate or flange of the member being joined. Face plates or flanges of such members are not to be welded to vertical plates of supports, but to be ended at a distance equal approximately to their twofold thickness and to be beveled at an angle close to 30°.

1.3.5.7 Knees (brackets) stiffening a deep member are to be fitted over the member web on one side at a distance not exceeding 3 m.

The thickness of tripping brackets is to be not less than that required for the deep member web. Brackets are to be brought to the face plate of the deep member. The bracket web is to be welded to the face plate of the deep member.

The width of tripping brackets measured at their base is to be not less than 1/2 of their depth, and at the place of their welding to the face plate, be 10 mm less than the width of the face plate supported.

1.3.5.8 Members adjacent on both sides to bulkheads, etc. are to be in one plane. The mismatch of planes of the intercostal member is not to exceed 1/2 of its thickness.

1.3.6 Openings in hull structures.

1.3.6.1 All the openings in longitudinal members of the ship's hull are recommended to be arranged so that their larger side is oriented along the ship.

1.3.6.2 All corners of any rectangular opening in longitudinal members are to be rounded on a radius of at least 0,1 of the opening width.

1.3.6.3 Openings (if more than one) in the shell plating and bulkheads are to be arranged so that they do not cause essential reduction of the hull cross-section. The longitudinal framing members cut with openings are to be properly compensated.

1.3.6.4 Lightening or communicating openings without compensation of their cross-sections are allowed in webs of bottom stringers and permeable solid floors if:

.1 the height of an opening does not exceed 0,5 of the member depth, and the axis of the opening is arranged in the middle of the member depth;

.2 the length of the opening does not exceed a twofold height;

.3 a distance between two adjacent openings is not less than the length of the smallest one;

.4 opening corners are properly rounded.

Where the total height of openings in the member web exceeds 0,5 of its depth, the web is to be stiffened.

1.3.6.5 No openings are allowed in the member web directly under the ends of brackets securing the member, as well as near supports. The opening edge is to be at a distance of at least 1/2 of the member depth from the bracket end. A distance from the edges of any opening in floors and members to the edges of openings for passage of longitudinal framing members is to be not less than the depth of these members.

1.3.6.6 The height of drain holes in framing is not to exceed 1/5 of the member depth, but not to be over 90 mm. The drain hole length is assumed equal to 15 thicknesses of plating adjacent to framing, but not to be over 150 mm. With increased scantlings of drain holes, the parts of framing weakened by openings are to be stiffened.

1.3.6.7 As far as practicable, no openings in the deck stringer, gunwale strake and cargo hatch coamings are allowed, as well as the welding of any components to free edges of the gunwale strake and to face plates of continuous coamings.

1.4 WELDED DETAILS AND JOINTS

1.4.1 Location of welds.

1.4.1.1 Welds are to be located in the least stressed sections of a structure as far as possible from the areas of abrupt changes of the members section, openings and areas deformed in a cold condition.

1.4.1.2 Congestion of welds, their crossings at an acute angle, as well as close location of parallel butt welds or fillet welds with butt ones are to be avoided. A distance between parallel welds, irrespective of their directions, is not to be less than:

200 mm — between parallel butt welds;

75 mm — between parallel fillet and butt welds;

50 mm — between parallel fillet and butt welds within the length not in exceeding 2 m.

The distance between the welds may be reduced on agreement with the Register.

The angle between two butt welds is to be at least 60° (Fig 1.4.1.2).

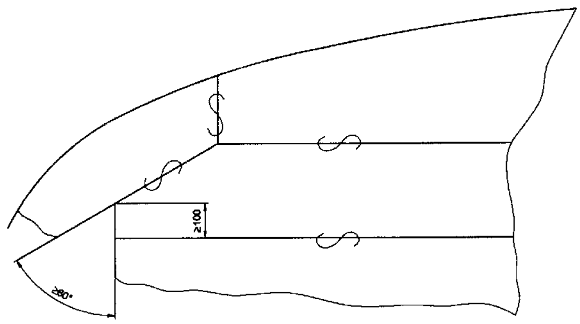


Fig 1.4.1.2

The assembling joints (seams) of plating and flooring are to be located at a distance of at least 200 mm from bulkheads, decks, inner bottom plating and deep members fitted parallel to the above joints.

The butt of a member web in assembling joints of welded framing members is to be located at a distance of at least 150 mm from the butt of the same member face plate.

On agreement with the Register, the butts of a web and face plate may be matched in the following cases:

.1 full penetration in the web-to-face plate joint at a length of at least 100 mm each side of the butt and non-destructive testing of every third member butt are ensured;

.2 the butt is overlapped by framing elements (knees, brackets, etc. fitted in line with the web) at a length not less than the face plate width each side of the butt.

1.4.1.3 Welded joints are not to be made within places subjected to cold bending of an internal radius less than three plate thicknesses. The distance from a weld to the beginning of such a bend is to be not less than three plate thicknesses. Welding in such places is allowed on agreement with the Register.

1.4.1.4 When butt welds and fillet welds meet, the last are to be provided with openings immediately above the places of intersections.

1.4.1.5 Thickened plates without use of doubling plates are to be fitted in the zone of local stress concentrations. However, if doubling plates are used, they are to be welded all around, and with a large surface, fixed by plug welds with a pitch not exceeding 30 thicknesses of the doubling plate.

1.4.2 Welded detailes.

1.4.2.1 The edges of brackets, member face plates and webs are to be welded all around and are to have no craters. The above also applies to drain and air holes and to openings for the passage of framing members and welds.

1.4.2.2 Joints of face plates of a coaming and hatch-end beams, as well as of intersecting members under variable dynamic loads are to be designed with smooth transitions (Fig. 1.4.2.2).

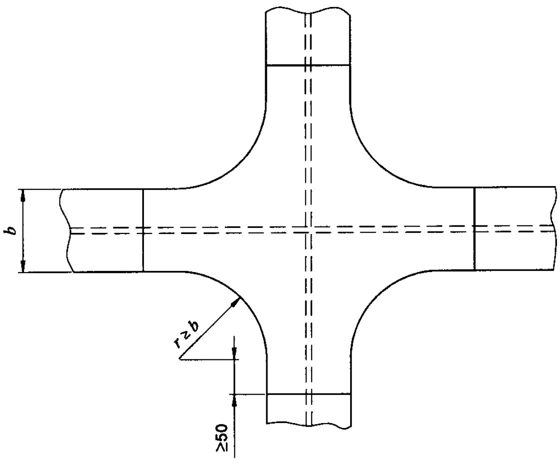


Fig. 1.4.2.2

1.4.2.3 Face plates of knees and brackets fitted for stiffening of deep members (longitudinal foundation girders inclusive) are not to be welded to face plates of the last.

1.4.2.4 It is not recommended to weld face plates of longitudinal foundation members to the plating of transverse bulkheads or the inner bottom.

1.4.2.5 Welding of member face plates to the opening edges is not allowed in units of member passage through permeable structures.

1.4.2.6 In order to arrange drain holes at transverse water-tight structures (bulkheads, floors), it is allowed not to bring longitudinal bottom and deck members till the webs of these structures. The distance between the girder face and structure web is not to exceed 20 mm.

1.4.3 Fillet welds.

1.4.3.1 Fillet welds of hull structures are to be continuous or intermittent in accordance with Table 1.4.3.2.

1.4.3.2 The design throat thickness a, in mm, of fillet welds for manual and semiautomatic welding is to be not less than:

for a single weld

$$a = 2{,}0\alpha s\, t/l; \qquad (1.4.3.2\text{-}1)$$

for a double weld

$$a = \alpha s\, t/l \qquad (1.4.3.2\text{-}2)$$

where α = weld factor according to Table 1.4.3.2; for structures in the area of cargo tanks of tankers the values of the factor α given in Table 1.4.3.2 are to be increased by 0,05;

s = lesser thickness of parts being joined, in mm;

Table 1.4.3.2

Nos	Name of joint	Weld factor	Welds allowed		
			staggered and chain	single continuous	single intermittent
1	Stem and stern frame, shaft struts, bar keel				
1.1	Separate parts among themselves and to shell	0,40			
2	**Bottom framing**				
2.1	Webs of bottom stringers and solid floors to shell plating, inner bottom plating and upper face plates of stingers and floors	0,20	×		
2.2	Webs of bottom stringers and solid floors to shell plating and face plates near the foundations of internal combustion engines	0,30			
2.3	Solid floors to bottom stringers	0,35			
2.4	Webs of solid floors to bilge strakes	0,40			
2.5	Watertight floors and bottom stringers to shell plating and inner bottom plating	0,35			
2.6	Bottom stringers to bulkheads	0,40			
2.7	Side and bottom frames to shell plating and innerbottom plating	0,15	×	×	×
2.8	Bottom longitudinals to shell plating and inner bottom plating	0,15	×	×	×
2.9	Inner bottom plating to shell plating and inner side plating	0,40			
3	**Side framing**				
3.1	Webs of deep frames and side stringers to shell plating and to their face plates	0,20	×		
3.2	Web frames and side stringers among themselves and to bulkheads	0,40			
3.3	Frames to shell plating and their face plates within 0,20 of the ship's length from perpendiculars, as well as in ballast and oil tanks, and in engine room	0,20	×		
3.4	Ditto, in all the remaining areas	0,15	×	×	×
3.5	Side longitudinals to shell plating	0,15	×	×	×
4	**Deck framing**				
4.1	Deck transverses and carlings to deck plating and face plates	0,20	×		
4.2	Deck transverses to side plating and carlings	0,40			
4.3	Carlings to bulkheads	0,40			
4.4	Hatch-end beams to deck plating, their face plates and shell plating	0,35			
4.5	Beams and deck longitudinals to deck plating	0,15	×	×	×
4.6	Beams and deck longitudinals to deck plating on cargo ships carrying deck cargo and on deck barges	0,20	×[1]		
4.7	Coamings of cargo hatches to deck and coamings of fans to deck	0,35			
4.8	Pillars to deck and inner bottom plating, pillar knees to pillars, decks, inner bottom and other members	0,40			
4.9	Deck stringers of strength decks to shell plating	0,50			
4.10	Deck stringers of other decks and platforms to shell plating	0,40			
4.11	Walls and bulkheads of superstructures to deck	0,40			
5	**Bulkheads**				
5.1	Vertical and horizontal frames to bulkhead plates, and to their face plates	0,20	×		
5.2	Vertical and horizontal frames among themselves and to face plates of bottom, side and deck framing	0,20			
5.3	Bulkhead stiffeners and horizontal girders to bulkhead plates, and to their face plates	0,15	×	×	×
5.4	Forepeak and afterpeak bulkheads of water and oil tanks to shell plating and deck	0,40			
5.5	Other watertight bulkheads to shell plating or to inner bottom plating and deck	0,35			
5.6	Longitudinal bulkheads to transverse bulkheads	0,40			

Table 1.4.3.2 — continued

Nos	Name of joint	Weld factor	Welds allowed		
			staggered and chain	single continuous	single intermittent
6	**Foundations**				
6.1	Plates, brackets and knees of foundations for internal combustion engines among themselves, to shell plating, inner bottom plating and face plates	0,40			
6.2	Girder plates of other engine and boiler foundations to shell plating, inner bottom plating and face plates	0,30			
6.3	Brackets and knees of engine and boiler foundations to girders	0,40			
6.4	Ditto, to face plates	0,30			
6.5	Top plates (face plates) to foundation webs, brackets and knees	0,50			
	[1] Only for ships not carrying trailers or wheeled vehicles.				

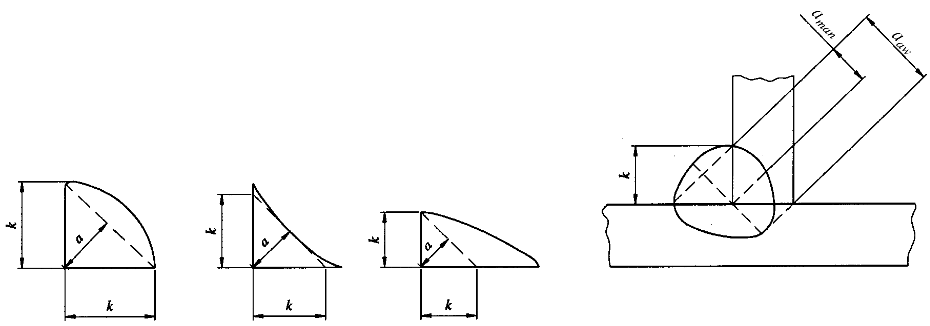


Fig. 1.4.3.2

t = weld pitch, in mm;
l = weld length, in mm.

In continuous welding, a ratio t/l in the Formulae (1.4.3.2-1) and (1.4.3.2-2) are assumed equal to 1.

The throat thickness of a fillet weld (its design height) is to be:

in manual welding

$$a_{\text{man}} = a; \quad (1.4.3.2\text{-}3)$$

in semiautomatic or automatic welding for the first run

$$a_{aw} \leqslant a \quad (1.4.3.2\text{-}4)$$

where a = height of an isosceles triangle inscribed into the cross-section of a bead (Fig. 1.4.3.2).

The relationship between the leg length of the fillet weld and the height of an isosceles triangle inscribed into the cross-section of a bead (refer to Fig. 1.4.3.2) is to be assumed equal to $k = 1{,}4a$ or $a = 0{,}7k$.

When semiautomatic or automatic welding is employed instead of the manual welding specified, the weld throat or leg (whichever is adopted in calculation) may be reduced for single-run welds by not more than 30 per cent. For multirun welds the above percentage is subject to special consideration by the Register.

The throat thickness of a fillet weld is to be not less than:

s, in mm	a, in mm
4	2,5
10	3,0
15	3,5
> 15	$0{,}2s + 0{,}5$

1.4.3.3 Single intermittent fillet welds are allowed up to the thickness of the part being joined equal to 5 mm.

1.4.3.4 The length l of a fillet weld for intermittent fillet welds is to be at least 50 mm and the weld pitch t, not more than 150 mm. The throat thickness of an intermittent fillet weld is to be not more than 0,6 of the plate thickness (up to the plate thickness of 6 mm – 0,7 of the plate thickness).

1.4.3.5 Double continuous fillet welds and scalloped welds only are allowed for welding of members on tankers.

1.4.3.6 In T-joints of hull structures exposed to essential impact and variable loads (foundations for internal combustion engines, etc.), the edges of adjacent webs over 8 mm thick are to have a double or single bevel, and welds are to have a concave section with a smooth transition to the surface of plates being joined (refer to Fig. 1.4.3.6).

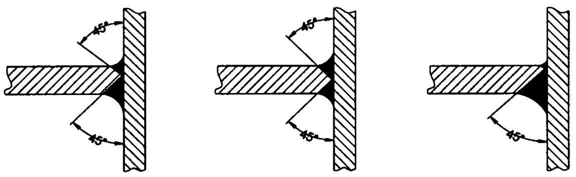


Fig. 1.4.3.6

1.4.4 Details welding.

1.4.4.1 Webs and face plates of free ends of bulkhead stiffeners and other members, i.e. of the ends not secured by brackets or not welded to a transverse member are to be welded on by a double continuous fillet weld having a weld factor α = 0,4 (refer to Fig. 1.4.4.1).

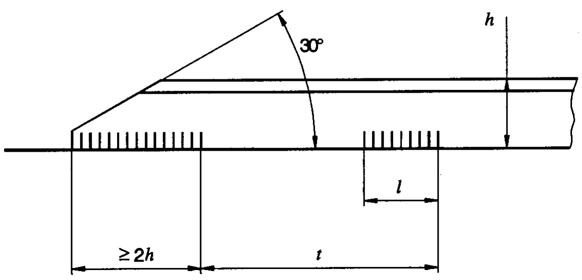


Fig. 1.4.4.1

1.4.4.2 The webs which edges have openings over 20 mm long are to be welded on by a double weld on both sides from the opening at a length equal to that of the intermittent weld employed (refer to Fig. 1.4.4.2).

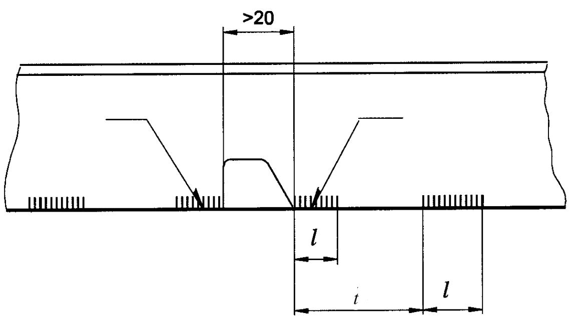


Fig. 1.4.4.2

1.4.4.3 Brackets are to be welded on to framing, plating and bulkheads by a double continuous fillet weld having a weld factor α = 0,4.

1.4.4.4 In those sections of a member where brackets are fitted, the welds employed for welding on the member web to the face plate, as well as to the plate being joined are to comply with the scantlings of the weld (length, leg) joining the bracket and the member.

1.4.5 Overlapping welding.

1.4.5.1 Overlapping connection are allowed for hull structures of the ships specified in 1.1.2.1 except:

.1 hull structures of tanks for the carriage or storage of dangerous liquids and gases;

.2 side, bottom and deck grillages of an engine room;

.3 hull structures in the area of main engines;

.4 bottom grillages in the area of propeller shaft supports;

.5 bottom structures in the area of propellers;

.6 stern structures in the area of a swinging propeller unit;

.7 hull structures in the area of auxiliary engines (sets) foundations on non-self-propelled ships;

.8 hull structures under production equipment on industrial ships;

.9 deep members except for overlapping welding to join the ends of main frames of a single ship's side with the ends of beams and floors (refer to 2.3.3), the joint of elements of bracketed floors of the double bottom and all-round frames of the inner side (refer to Fig. 2.10.3), as well as the joint of elements of all-round frames of ship-platforms (refer to 3.3.2.1, and also the requirements of 1.3.1.7);

.10 longitudinal deep members and longitudinal bulkheads in the area of tow knees of pushers and the ships pushed;

.11 areas exposed to essential concentrated loads;

.12 parts of hull structures subjected to essential forces (at the level of allowable stresses), as well as members potentially overloaded in service.

1.4.5.2 Arranging overlapping welds the requirements of 1.4.1.1 and 1.4.1.2 are to be met.

1.4.5.3 The lapping of details for overlapping welding is to be not less than b, in mm determined by the following formula:

$$b = 1{,}5s + 20 \qquad (1.4.5.3)$$

where s = thickness of the thinner of the plates joined, in mm.

1.4.5.4 Overlapping joints of hull structures are to be welded all around by a continuous fillet weld on both sides so that they form a closed contour. The weld factor of the fillet weld is to be 0,4.

1.4.5.5 Butts and seams of shell plating, inner-bottom and inner side plating may be welded on a backing strap which thickness is to be not less that that of the thicker of the plates joined; the strap is to be situated on the inside of the plating. Edges of plates therewith are to be arranged, as far as is practicable, in a line (refer to Fig. 1.4.5.5). The spacing between plate edges is to be at least $3s_1$, where s_1 is the largest among the thicknesses of details being joined.

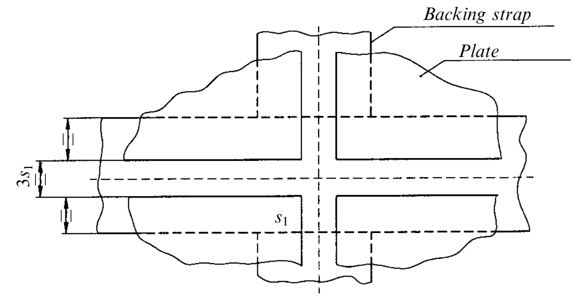


Fig. 1.4.5.5

1.4.5.6 The backing strap mentioned in 1.4.5.5 is to be joined to the plate of a transverse bulkhead or frame for plating butts, and to the plate of an inner bottom, a side stringer or platform for plating seams. It is allowed to use rolling sections as the backing strap of plating (refer to Fig. 1.4.5.6).

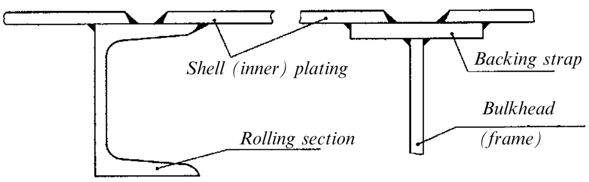


Fig. 1.4.5.6

The joint of the deep member web or bulkhead plate and the backing strap of shell or inner plating is to be situated between two inner welds of joints on the backing strap.

1.4.5.7 The bilge overlapping joint of plates of bottom and side plating on an angle section is allowed only on arrangement with the Register.

1.4.5.8 The butts of deep member webs and flange plates at a distance of less than 150 mm from the relevant edges of overlapping shell plates are not allowed (refer to Fig. 1.4.5.8).

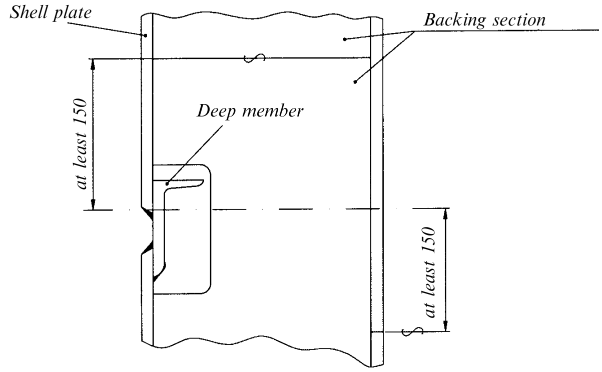


Fig. 1.4.5.8

2 DETERMINATION OF SCANTLINGS AND STRUCTURE OF HULL MEMBERS

2.1 SHELL PLATING

2.1.1 Bottom plating.

2.1.1.1 Where transverse framing for the bottom is adopted, the bottom plates thickness s, in mm, is to be not less than determined by the following formulae:

.1 on cargo non-self-propelled ships:

$$s = 1{,}55ka\sqrt{L} \qquad (2.1.1.1.1)$$

where k = 1 through the whole length of the ship at the loading sequence "B" and for the ship's ends at the loading sequence "A";
k = (0,35 $+c_b$), but not less than 1 at the loading sequence "A" for the midship;
c_b = block coefficient;
a = distance between floors, but not less than 0,5 m;

.2 on cargo self-propelled ships within $0{,}5L$ amidships:

$$s = 1{,}55ka\sqrt{L} + 0{,}5 \qquad (2.1.1.1.2)$$

where for k, c_b and a = refer to the Formula (2.1.1.1.1).

Outside the specified area towards the ship's ends, the plate thickness may gradually decrease in 1 mm down to a thickness s, in mm, determined by the Formula (2.1.1.1.1);

.3 on passenger ships within $0{,}5L$ amidships:

$$s = 0{,}6a\sqrt{L(mc_b^3 - n)(2{,}1 - 1{,}3l_n/L)}\sqrt{1{,}7 - 3{,}5l_m/L} + 0{,}015L \qquad (2.1.1.1.3)$$

where c_b = block coefficient, but not less than 0,60;
l_n – length of the first tier of a superstructure, in m;
l_m = length of the engine room, in m;
m, n = values assumed according to Table 2.4.1.1;

.4 on tugs within $0{,}5L$ amidships:

$$s = 1{,}2a\sqrt{(N/169)L[m(c_b - 0{,}15)^3 - n](1{,}7 - 2{,}34l_m/L)} + 0{,}015L \qquad (2.1.1.1.4)$$

where l_m = length of the engine room, in m;
m, n = values assumed according to Table 2.4.1.1;
N = total specified output of main engines, in kW;

.5 on pushers through the whole length of the ship:

$$s = 1{,}3a\sqrt{2L[m(c_b - 0{,}15)^3 - n](1{,}7 - 1{,}4l_m/L)} + 0{,}015L \qquad (2.1.1.1.5)$$

where l_m = length of the engine room, in m;
m, n = values assumed according to Table 2.4.1.1;

.6 on industrial ships within $0{,}5L$ amidships:

$$s = 1{,}2a\sqrt{(N/132)(L+4)(0{,}28+0{,}8c_b)(1{,}7-1{,}75l'_m/L)} + 0{,}015L \qquad (2.1.1.1.6)$$

where l'_m = length of the engine room including the deck parts where machinery of production equipment is located, but not more than $0{,}6L$, in m;
N = total specified output of main engines, in kW;

.7 in addition, the adopted thickness of bottom plates amidships is to be not less than that determined by the following formulae:

for tugs and industrial ships

$$s = 1{,}7a\sqrt{L} + 0{,}5; \qquad (2.1.1.1.7\text{-}1)$$

for passenger ships

$$s = 3{,}25 + 0{,}025L \qquad (2.1.1.1.7\text{-}2)$$

where a = spacing of floors or bottom longitudinals, but not less than 0,5 m.

2.1.1.2 On passenger ships, tugs and industrial ships outside the midship towards the ship's ends, the bottom plates thickness determined according to 2.1.1.1 may gradually decrease down to the thickness, in mm, equal to:

$$s_0 = 5{,}5a\sqrt{d + 0{,}6}. \qquad (2.1.1.2)$$

If the thickness $s_0 > s$ determined according to 2.1.1.1, the thickness of all the plates through the whole length of the ship is to be equal to the thickness so, but not less than 3 mm, on tankers – not less than 5 mm.

2.1.1.3 Where the bottom has stringers complying with 2.2.4.5, the thickness s determined by the formulae of 2.1.1.1 may be reduced by 6 per cent with three bottom stringers and by 3 per cent for each additional bottom stringer.

2.1.1.4 Where longitudinal framing for the bottom is adopted, the bottom plates thickness determined according to 2.1.1.1 may be reduced by 30 per cent. In this case, the value of a in the formulae is assumed equal to the spacing of bottom longitudinals.

2.1.1.5 On all the types of ships and with any framing system the bottom plating thickness is not to be less than s_0 determined according to 2.1.1.2, but in any case not less than 3 mm.

2.1.2 Local thickening of bottom plating.

2.1.2.1 Bottom plating thickness of cargo ships, except pushed barges, over the length equal to a distance from a stem to the forepeak bulkhead plus 1 m is to be increased by not less than 1 mm as compared with the thickness required in 2.1.1.1 and 2.1.1.3 or 2.1.1.4.

Where an underdeck accommodation space is located before a cargo hold, a thickened plating is to be extended till the aft bulkhead of the fore accommodation space.

2.1.2.2 The thickness s, in mm, of bottom plates joined to foundations under main engines is to be not less than that determined by the following formula:

$$s = 0{,}8\sqrt{L}(1 + 16{,}3N_1/nL) \qquad (2.1.2.2)$$

where N_1 = specified output of one main engine, in kW;
n = number of revolutions of main engines, in rpm,

but not less than the thickness of adjacent plates.

2.1.2.3 Keel strake.

If ships with deadrise are not fitted with a bar keel, they are to have a keel strake of bottom plating the width of which is to be not less than $0{,}1B$. The thickness of the keel strake is to be increased by 2 mm as compared with the thickness required for bottom plating in accordance with 2.1.1.

2.1.3 Bilge plates.

2.1.3.1 Bilge plates thickness s, in mm, of cargo ships is to be not less than that determined by the following formula:

$$s = 1{,}15\sqrt{L} \qquad (2.1.3.1)$$

but not less than the thickness of adjacent plates of bottom or side plating, whichever is greater.

2.1.3.2 Bilge plates thickness on the ships not specified in 2.1.3.1 is to be at least by 1 mm greater than the thickness of adjacent plates of bottom or side plating, whichever is greater.

2.1.3.3 Bilge plates thickness outside the parallel middlebody of the ship's hull may be reduced to bottom plates thickness actually adopted.

2.1.3.4 Both edges of a bilge strake are to overlap the boundaries of a bilge turn by at least 100 mm. In any case, the top edge of the bilge strake is to be by 60 mm above the top edge of floors.

2.1.4 Side plating.

2.1.4.1 Side plating thickness s, in mm, for cargo ships is to be not less than that determined by the following formula:

$$s = 1{,}55a\sqrt{L} \geqslant 6{,}0 \text{ mm}, \qquad (2.1.4.1)$$

but not greater than the thickness of bottom plating in the relevant place.

Side plating thickness on ships of other types is to be equal to the thickness of bottom plating in the relevant place.

Side plating thickness in way of hawse pipes is to be increased by 50 per cent.

2.1.4.2 Sheer strake.

The sheer strake amidships or within the cargo holds of cargo ships is to be not less than that determined by the following formula:

$$b_s = 0{,}1D. \qquad (2.1.4.2\text{-}1)$$

The sheer strake thickness s is to be not less than that determined by the following formula:

$$s = 2{,}8a\sqrt{L} \geqslant 12{,}0 \text{ mm.} \qquad (2.1.4.2\text{-}2)$$

The sheer strake thickness amidships is to be not less than that of the adjacent plates of side plating or a deck stringer, whichever is greater.

The sheer strake thickness outside the above limits may gradually decrease down to side plating thickness.

2.1.4.3 Openings at the top edge of a sheer strake are not allowed, as well as in side plating if a distance form the opening top to the strength deck is less than half the opening height. Other cases are subject to special consideration by the Register.

Corners of rectangular openings in side plating, are to be rounded in radius not less than 0,1 of the opening height or width, whichever is less, but not less than 50 mm.

In all cases when essential reduction of longitudinal or local strength due to the presence of openings may be expected, reinforcements in way of openings are to be provided.

Reinforcements like thickened insert plates are compulsory for openings within the area of $0{,}35L$ from the middle section with their top point located less than the opening height from a strength deck. The minimum width of the thickened insert plate measured from the opening top or bottom is to be 0,25 of the opening height or length, whichever is less; the total width measured outside the opening is to be greater than the minimum one by not less than 0,25 of the opening height or length, whichever is less. The minimum distance from the end the thickened insert plate to the opening point nearest to it measured along the ship is to be 0,35 of the opening height or length, whichever is less. Corners of the thickened insert plate are to be rounded. The thickened insert plate thickness is to be at least 1,5 times side plating thickness in way of the opening. The thickened insert plate may be fitted across the entire perimeter of openings.

2.2 BOTTOM FRAMING ON SHIPS WITHOUT DOUBLE BOTTOM AND IN AREAS WHERE DOUBLE BOTTOM IS UNAVAILABLE

2.2.1 Solid floors.

2.2.1.1 Solid floors for transverse framing of bottom are to be fitted in accordance with the arrangement of frames (according to 2.3.1.1), i.e. at every frame in the engine and boiler room, and in peaks, as well as in the holds of ships for the carriage of ore and heavy cargoes. Solid floors in remaining spaces are to be fitted at least at every fourth frame. Bottom frames are to be fitted between solid floors in accordance with 2.2.2.

2.2.1.2 Solid floors for longitudinal framing of bottom are to be fitted in accordance with the arrangement of frames according to 2.3.1, at least at every fourth frame; in this case, a distance between solid floors or from a transverse bulkhead to the floor is to be not greater than 2,4 m.

2.2.1.3 The section modulus of solid floors W, in cmi, in the cargo hold, under loading sequence "A" is not to be less than that determined by the following formula:

$$W = 4{,}4ka_1B_1^2(d + 0{,}6) \qquad (2.2.1.3)$$

where a_1 = solid floors spacing, in m;
B_1 = solid floor span measured between its supports, but not less than $0{,}5B$, in m.
Solid floor supports are considered the ship's hull sides, longitudinal bulkheads, as well as inner skins, if they comply with 2.9.9;
k = factor equal to:
1,2 — for longitudinal framing of bottom and sides;
1,6 — for transverse or longitudinal framing of bottom and transverse side framing;
1,75 — for transverse bottom framing and longitudinal side framing;
2,0 — for longitudinal bottom and side framing on ships for the carriage of ore and heavy cargoes;
3,0 — for transverse or longitudinal bottom framing and transverse or longitudinal side framing on ships for the carriage of ore and heavy cargoes.

The value of W obtained from Formula (2.2.1.3) may be reduced by 20 per cent under loading sequence "B".

2.2.1.4 The moment of inertia of solid floors in the cargo hold I_p, in cm^4, for longitudinal bottom framing is to be not less than that determined by the following formula:

$$I_p = 0{,}145I_vn(B_1/a_1)^3 \qquad (2.2.1.4)$$

where I_v = moment of inertia of the bottom longitudinal with an effective flange, in cm^2;
n = number of bottom longitudinals crossing the span B_1;
for a_1, B_1 = refer to 2.2.1.3.

2.2.1.5 Where bottom stringers complying with 2.2.4.5 are available, the section modulus of solid floors in the cargo hold according to 2.2.1.3 may be reduced by its multiplying by the factor k_1 determined by the following formula:

$$k_1 = k_0[1 + 0{,}25(I_p/I_n - 0{,}83)] \qquad (2.2.1.5)$$

where I_p = moment of inertia of the floor, in cm^4;
I_n = moment of inertia of the bottom stringer, in cm^4;
k_0 = factor according to Fig. 2.2.1.5 depending on l/B_1;
l = span of the bottom stringer measured between bulkheads, in m;
for B_1 = refer to 2.2.1.3.

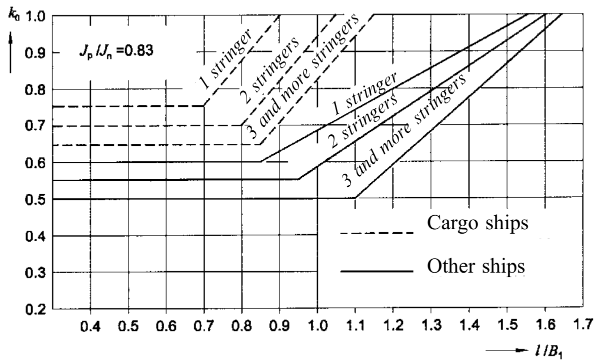


Fig. 2.2.1.5

2.2.1.6 The floor depth in a cargo hold on ships with the bottom deadrise is to be increased in the ship's central plane by 1/3 of the height of the deadrise measured at the ship's side. The floor web depth at sides is to be not less than the double depth of a side frame.

2.2.1.7 Solid floors in the cargo hold of open ships are to be of reinforced design (refer to 3.4.3).

2.2.1.8 The section modulus of solid floors in the engine room W, in cm^3, is to be not less than that determined by the following formula:

$$W = 6{,}5\, a\,(d + 0{,}6)B^2 + 20. \qquad (2.2.1.8)$$

Floors are to be made of welded T-sections. The floor depth at the place of an opening for an engine is to be as large as possible; the floor section modulus in this cross-section is to be at least 75 per cent of the value according to the Formula (2.2.1.8). The floor face plate is to be stiffened by brackets fitted at opening corners (refer to Fig. 2.2.1.8).

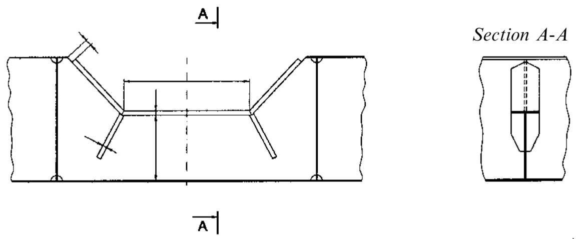


Fig. 2.2.1.8

2.2.1.9 In case bottom stringers in amounts of four and more being the foundations of main engines with elastic installation are arranged over the entire length of the engine room, floors section modulus according to the Formula (2.2.1.8) may be reduced by 20 per cent when the length to width proportion for the engine room is equal to 1 or less.

2.2.1.10 Floors web thickness in a forepeak and after peak is to be $0{,}8\sqrt{L}$, but at least 4 mm. The section modulus of these floors is to be not less than that determined for the floors of cargo holds by the Formula (2.2.1.3) using $k = 1{,}6$.

Floors in afterpeaks of self-propelled ships with fine stern lines are to be, if possible, brought out over a stern tube.

2.2.1.11 Meeting the requirement of 2.2.1.10 for ships in **Zone 3** is not compulsory on agreement with the Register; in this case solid floors in peaks are to be dimensioned as those amidships.

2.2.1.12 The section modulus of solid floors in accommodation spaces, stores and other spaces not specified in 2.2.1.3, 2.2.1.8 and 2.2.1.10 W, in cm^3, is to be not less than that determined by the following formula:

$$W = kk_1a_1(d + 0{,}6)B_1^2 \qquad (2.2.1.12)$$

where k = 4,5 – for longitudinal bottom framing;
k = 6,0 – for transverse bottom framing;
for k_1 = refer to 2.2.1.5;
for a_1, B_1 = refer to 2.2.1.3.

2.2.1.13 Floors joined to web frames arranged according to 2.3.6.1 are to be made of a welded T-section. The cross-sectional area or their face plate is, in this case, to be not less than the twofold cross-sectional area of the solid floor face plate. Reinforcement of solid floors joined to the web frames having a span of 2 m and less is not required.

2.2.2 Bottom frames.

2.2.2.1 The section modulus of bottom frames W, in cm^3, between solid floors is not to be less than that determined by the following formula:

$$W = 7{,}1a(d + 0{,}6)b^2 \qquad (2.2.2.1)$$

where b = bottom frame span measured between supports, but not less than $B/4$, in m. Bottom frame supports are considered the ship's hull sides, longitudinal bulkheads, inner skins, pillars and solid side girders.

2.2.2.2 The moment of inertia of bottom frames I, in cm^4, is not to be less than that determined by the following formula:

$$I = 3\left(2 - \frac{d - a_1}{a}\right)(s/a)B_1^4, \qquad (2.2.2.2)$$

where b = refer to the Formula (2.2.2.1);
s = thickness of bottom plating, in cm.

2.2.2.3 On ships of rectangular pontoon shape, intermediate bottom frames having the section modulus equal to 60 per cent of that for side frames according to 2.3.2 but not less than 6 cm^3, are to be fitted within the forepeak between solid floors.

2.2.3 Bottom longitudinals.

2.2.3.1 Longitudinal bottom framing is recommended for all the ship's compartments except the engine room and afterpeak of self-propelled ships. The spacing of bottom longitudinals is not to exceed 0,60 m.

2.2.3.2 If a ship has a bilge of over 500 cm radius and longitudinal side framing, at least one longitudinal is to be arranged in the area of the bilge turn.

2.2.3.3 On dry cargo ships except those specified in 2.2.3.5, the section modulus W, in cm^3, of bottom longitudinals taking up a cargo load is to be not less than that determined by the following formulae:

for loading sequence "A"

$$W = 1{,}8a(D + d + L/40)l^2; \qquad (2.2.3.3\text{-}1)$$

for loading sequence "B"

$$W = 1{,}3a(D + d + L/30)l^2 \qquad (2.2.3.3\text{-}2)$$

where a = bottom longitudinals spacing, in m;
l = longitudinals span including attachments of their ends, in m. Longitudinal supports are considered transverse bulkheads and solid floors.

2.2.3.4 On dry cargo ships the section modulus of bottom longitudinals not loaded by cargo is to be not less than that determined by the following formula:

$$W = 5{,}2a(d + L/80)l^2 \quad (2.2.3.4)$$

where l = longitudinals span including attachments of their ends, in m. Longitudinal supports are considered transverse bulkheads and solid floors.

2.2.3.5 On cargo ships for the carriage of ore or other heavy cargoes, the section modulus of bottom longitudinals W, in cm^3, taking up a cargo load is to be not less than that determined by the following formulae:

for loading sequence "A"

$$W = 3a(D + d + L/70)l^2; \quad (2.2.3.5\text{-}1)$$

for loading sequence "B"

$$W = 2{,}1a(D + d + L/50)l^2 \quad (2.2.3.5\text{-}2)$$

where l = longitudinals span including attachments of their ends, in m.

2.2.3.6 The section modulus of bottom longitudinals W, in cm^3, on ships not specified above is to be not less than that determined by the following formula:

$$W = 5{,}2a(D + 0{,}6 + L/200)l^2 \quad (2.2.3.6)$$

where l = longitudinals span including attachments of their ends, in m.

2.2.3.7 The flexibility of the bottom longitudinal is to meet the following condition:

$$\lambda = 100l/\sqrt{I_v/f_e} \leqslant 100 \quad (2.2.3.7)$$

where f_e = cross-sectional area of the longitudinal with an effective flange, in cm^2;
I_v = inertia moment of the longitudinal, in cm^4;
l = longitudinals span including attachments of their ends, in m.

2.2.3.8 Bottom longitudinals are to be continuous from one transverse bulkhead to another. Their joint to solid floors is to meet the requirements of 1.3.2.1.

2.2.3.9 Bottom longitudinals discontinued at watertight transverse bulkheads are to be connected to the bulkhead by means of vertical brackets dimensioned according to 1.3.4.

A gap between the longitudinal ends and bulkhead plating is to be not greater than 20 mm (refer to Fig. 2.2.3.9).

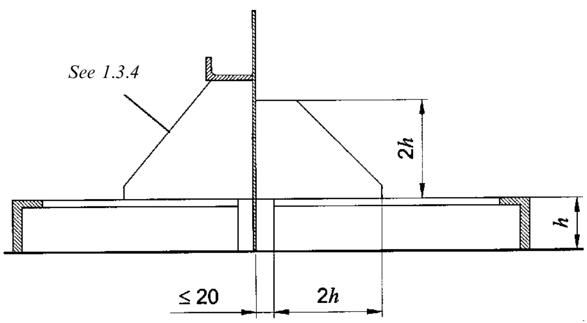


Fig. 2.2.3.9

2.2.3.10 Bottom longitudinals of a large depth may not be joined to a transverse bulkhead by means of vertical brackets if their flange (face plate) runs through the bulkhead or is attached to the bulkhead with horizontal brackets which width is equal to the twofold width of the flange (face plate), and a web is welded on to the bulkhead in accordance with the requirement 2.1 of Table 1.4.3.2.

2.2.4 Bottom stringers and vertical keel.

2.2.4.1 On all self-propelled cargo ships, on non-self-propelled cargo ships at loading sequence "A", regardless of bottom framing system, and on all ships with bottom framing of alternating solid floors and bottom frames, bottom stringers are to be fitted and numbered so that their spacing, as well as their distance from the ship's sides do not exceed 2,5 m. In sections where the above ships have the bottom deadrise, one of the bottom stringers is to be arranged in the ship's central plane.

2.2.4.2 On ships not specified in 2.2.4.1 having a breadth B less than 6 m or the bottom deadrise, regardless of bottom framing system the vertical keel only fitted in the ship's central plane is adequate.

2.2.4.3 The vertical keel is to run along the ship from stem to stern frame, and on pontoon-shaped ships, till end transoms. The vertical keel in the engine room may be unnecessary if longitudinals of the engines foundation within the engine room are continuous and the end parts of the vertical keel are extended in the engine room for at least two spacings.

2.2.4.4 Where the vertical keel is not fitted in the ship's central plane, its installation within the forepeak and afterpeak is necessary except pontoon-shaped ships.

2.2.4.5 The depth and thickness of the vertical keel web within cargo holds are to be not less than those required for solid floor webs, and the cross-sectional area with a face plate, not less than that specified in Table 2.2.4.5.

Table 2.2.4.5

Ship's breadth, in m	Cross-sectional area of the bottom stringer (vertical keel), in cm^2
over 2,5 to 6	6,0
from 6 to 9	9,0
from 9 to 12	11,0
from 12 to 15	13,5

The vertical keel web may be continuous or discontinued between floors. In both cases a face plate is to be continuous between bulkheads.

Within the ship's other compartments, the vertical keel design is to be similar to the above, but the continuous face plate therewith is to have a cross-sectional area equal to that of the flange or face plate of solid floors.

2.2.4.6 Bottom stringers are to be dimensioned like solid floors except ships with a loading sequence "A" on which bottom stringers are to be designed like the vertical keel in accordance with 2.2.4.5. The face plate (flange) of the bottom stringer may be welded to face plates of T-section floors (refer to Fig. 2.2.4.6-1). The welding-on of the bottom stringer face plate (flange) to floor flanges is not allowed if the unit is applied to Fig. 2.2.4.6-2, the bottom stringer face plate therewith is to be continuous.

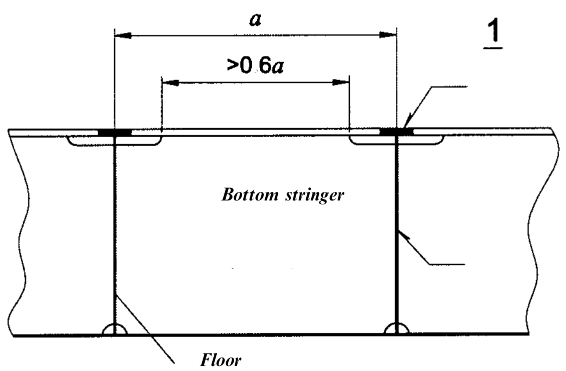


Fig. 2.2.4.6-1

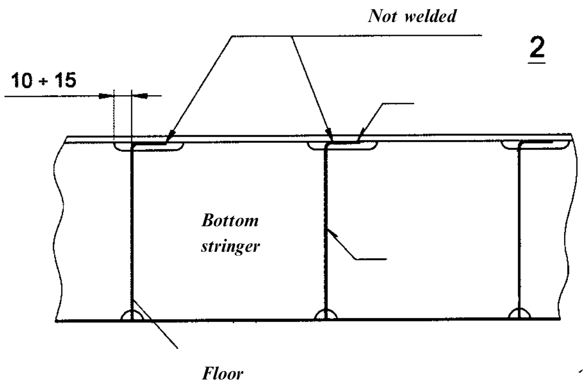


Fig. 2.2.4.6-2

2.2.4.7 Brackets of at least two spacings long are to be fitted behind bulkheads where bottom stringers end at transverse bulkheads.

2.2.4.8 Faces of bottom stringers at transverse bulkheads are to be welded all around. In order to attach bottom stringers to bulkheads, horizontal brackets are recommended for use, which are fitted on both sides of a face plate. The bracket size along the bulkhead is to be equal to the width of the face plate, and that along the bottom stringer, to the twofold width of the face plate.

2.3 SIDE FRAMING

2.3.1 Arrangement of side framing members, spacing.

2.3.1.1 The spacing of transverse side framing is to be not greater than 0,6 m. It is recommended to adopt the spacing not more than 0,5 m for small ships having shell plating of 4 mm thick and less, and also for industrial ships.

2.3.1.2 For longitudinal side framing a distance between longitudinals is not to exceed 0,60 m, and a distance between web frames is to be not greater than 2,4 m. The longitudinal side framing may be used in all the ship's compartments.

2.3.2 Frames.

2.3.2.1 The frame section modulus W, in cm^3, is to be determined by the following formula:

$$W = 3{,}8aDl^2 + 2 \qquad (2.3.2.1)$$

where l = distance measured over the ship's side between the top edge of a floor and the lower edge of a beam, in m.

Where one side stringer is fitted, according to 2.3.7.4 the value of the section modulus W may be reduced by 35 per cent, but it is to be at least 10 cm^3, and for passenger ships, at least 6 cm^3.

2.3.2.2 On passenger ships and industrial ships, the section modulus according to the Formula (2.3.2.1) may be reduced by 25 per cent, but it is not to be less than 6 cm^3.

2.3.2.3 The section modulus of frames in way of fuel oil or ballast tanks is to be increased by 10 per cent as compared with that required according to 2.3.2.1; it is to be therewith not less than the section modulus of the tank bulkhead stiffener required by 2.8.3.

2.3.2.4 The section modulus of frames to which deep beams are attached at longitudinal deck framing and transverse side and bottom framing, is to be increased by 100 per cent as compared with the value specified in 2.3.2.1.

2.3.2.5 Frames for open ships are to be of reinforced design (refer to 3.4).

2.3.3 Frames attachment.

2.3.3.1 Frame ends and floors are to be joined as shown in Fig. 2.3.3.1 or in another similar way. Contour welding is required for overlapping joints.

Frame ends and beams are to be joined by means of brackets dimensioned according to the requirements of 1.3.4.

2.3.3.2 Frames and outer bottom and deck longitudinals at longitudinal bottom and deck framing and at transverse side framing are to be joined by means of brackets according to Fig. 2.3.3.2.

The size of a bilge bracket side is to be equal to the solid floor depth, and a thickness to that of the floor web.

2.3.4 Fore intermediate frames.

2.3.4.1 In the ship's fore part at a distance of the ship's breadth B away from the fore perpendicular, the normal spacing is to be reduced down to the half by means of installation of intermediate frames.

The section modulus of intermediate frames is to be 60 per cent of that for frames according to 2.3.2. In any case it is to be at least 6 cm^3.

2.3.4.2 Intermediate frames in the fore part of the ship with flat bottom are fitted only at sides and the floors in their plane may be unnecessary. However, with

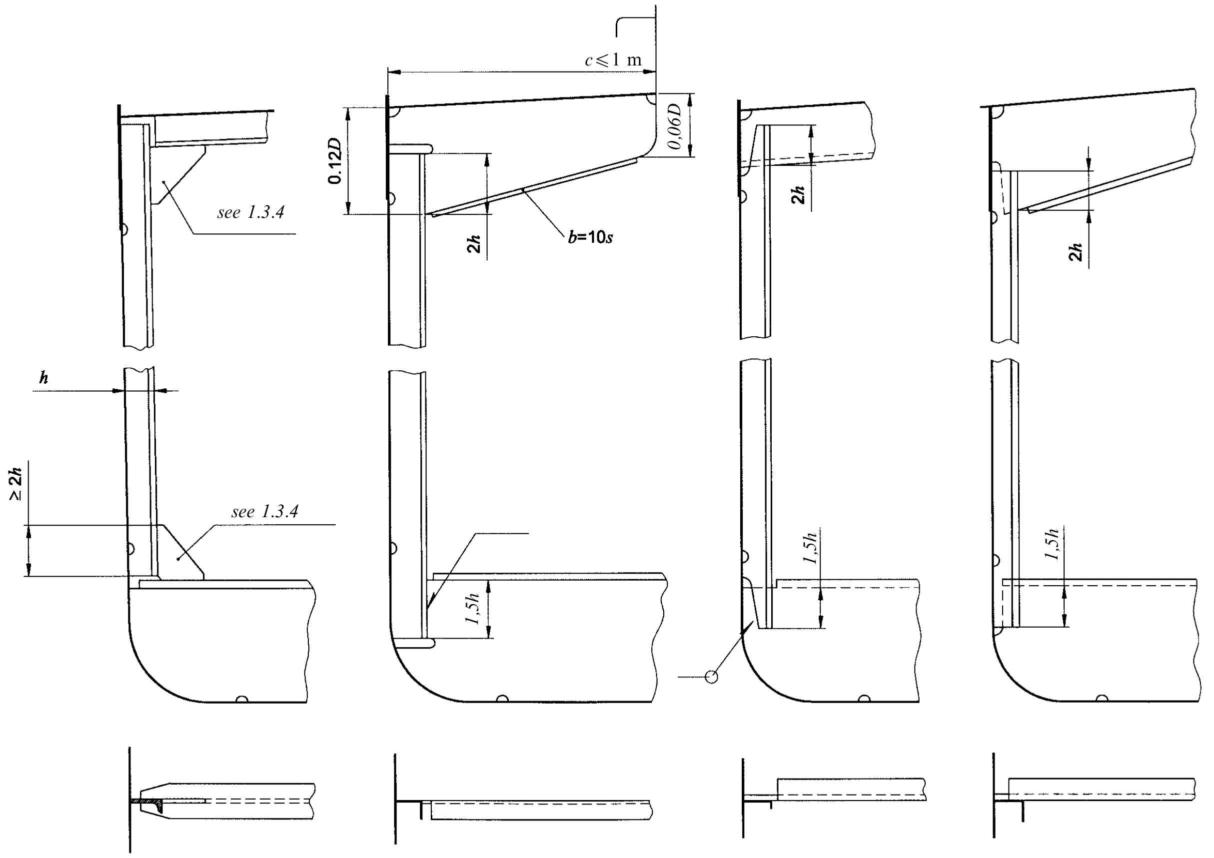


Fig. 2.3.3.1

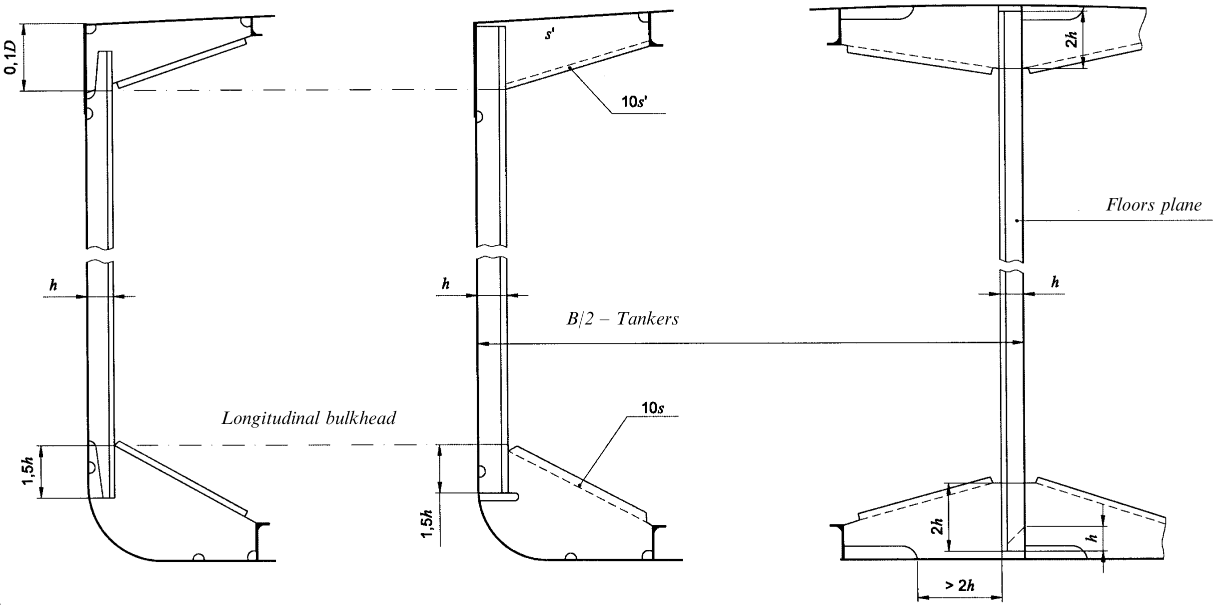


Fig. 2.3.3.2

bottom deadrise in the ship's fore part, intermediate frames are to be extended till the ship's central plane.

2.3.4.3 The use of intermediate side frames on the ships having a rectangular pontoon-like shape is not compulsory; bottom frames are to comply with 2.2.2.2.

2.3.4.4 The ends of intermediate frames may be beveled according to 1.3.2.2 and welded on according to 1.4.4.

2.3.5 Side longitudinals.

2.3.5.1 The section modulus of side longitudinals W, in cm^3, is to be not less than that determined by the following formula:

$$W = 5{,}3a(d + 0{,}6)l^2 \qquad (2.3.5.1)$$

where l = side longitudinal span measured between its supports, in m. Side longitudinal supports are considered web frames and transverse bulkheads.

The section modulus of side longitudinals for all ships is to be at least 10 cm^3, and for passenger ships, at least 6 cm^3.

2.3.5.2 The section modulus according to 2.3.5.1 for passenger ships and industrial ships may be reduced by 15 per cent, but it is not to be less the above-specified minimum value.

2.3.5.3 On ships with longitudinal bottom or deck framing the scantlings of an outer side longitudinal at bottom or at deck are to be equal to those of bottom or deck longitudinals.

2.3.5.4 Side longitudinals are to be continuous between bulkheads. They are to be joined to web frames in accordance with the requirements of 1.3.2.

Longitudinals are to be joined to the bulkhead by brackets dimensioned according to 1.3.4. A distance form side longitudinal ends to bulkhead plating is to be not greater than 20 mm.

Longitudinals are attached to bulkheads with stiffeners according to Fig. 2.2.3.9.

2.3.6 Web frames.

2.3.6.1 With transverse side framing the minimum number of web frames in all the compartments outside the engine room is determined by Table 2.3.6.1 depending on a distance between watertight transverse bulkheads.

Table 2.3.6.1

Distance between bulkheads	Number of web frames
from 6 to 10 m inclusive	1
from 10 to 15 m	2
from 15 to 20 m	3
from 20 m	At a distance not greater than 5 m apart

2.3.6.2 A distance between web frames or their distance from transverse bulkheads in engine rooms is not to exceed 2 m. Their arrangement is to be such that they are located in places where main engines foundations end.

2.3.6.3 At transverse side framing with alternating web and main frames and a side stringer, a distance between web frames is not to exceed the value specified in Table 2.3.6.1.

2.3.6.4 Scantlings of web frames in all the ship's compartments, except the engine room, are determined as follows:

.1 if transverse bottom and side framing, longitudinal bottom and side framing, longitudinal bottom and transverse side framing are used, the section modulus of web frames is to be equal to that of solid floors according to 2.2.1.3, 2.2.1.10 or 2.2.1.12 where a distance between web frames is 5 m. Where the distance between web frames is under 2 m, the section modulus is to be at least 50 per cent of that value. With the distance between web frames within 2 m to 5 m, the section moduli are determined by linear interpolation between these values;

.2 if transverse bottom and longitudinal side framing is used, the section modulus of web frames W, in cm^3, is to be not less than that determined by the following formula:

$$W = W_f(a_w/a_{w\max} + a_w/a'_w) \qquad (2.3.6.4\text{-}1)$$

where W_f = floor section modulus according to 2.2.1.3, in cm^3;
a_w = distance adopted between web frames, in m;
a'_w = distance between web frames at transverse side framing determined according to Table 2.3.6.1, in m;

$$a_{w\max} = 0{,}5a(B/D)^2 + 5{,}6/D^2. \qquad (2.3.6.4\text{-}2)$$

2.3.6.5 The section modulus of web frames in the engine room W_w, in cm^3, is to be not less than that determined by the following formula:

$$W_w = (a_w/a)W(1 + 0{,}82\sqrt{N/n}) \qquad (2.3.6.5)$$

where W = frame section modulus calculated by the Formula (2.3.2.1), in cm^3;
N = specified output of the main engine, in kW;
n = number of revolutions of the main engine, in rpm.

2.3.6.6 Web frames are recommended to be made of a welded T-section; their joint to solid floors and deep beams is to be made according to Figs. 2.3.6-1 to 2.3.6-3 or in another similar way. On agreement with the Register, face plates of web frames may be replaced with flanges bent back.

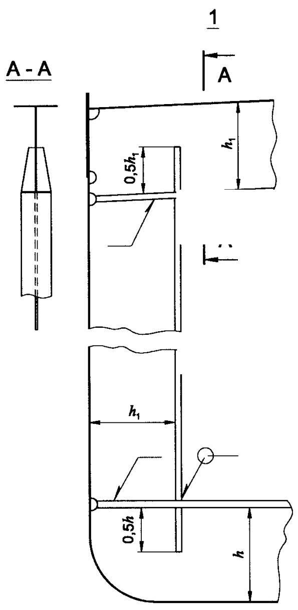
2.3.6.7 Open ships are to have web frames of reinforced design (refer to 3.4).

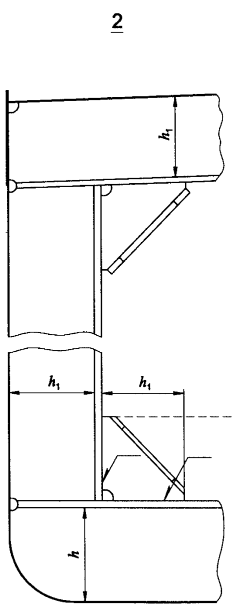
2.3.7 Side stringers.

2.3.7.1 Where the ship's depth measured at a distance of $0{,}05L$ away from the fore perpendicular exceeds 2,5 m (up to 4 m inclusive), a side stringer at a height of about $0{,}6D$ above the bottom, and two side stringers with the ship's depth over 4 m are to be fitted in the fore part of the ship.

For wall-sided pontoon-shaped ships the side stringers specified above may be unnecessary.

Side stringers are to be fitted from the stem to the place of the ship's full breadth, but they are to be arranged within the entire fore underdeck accommodation space.





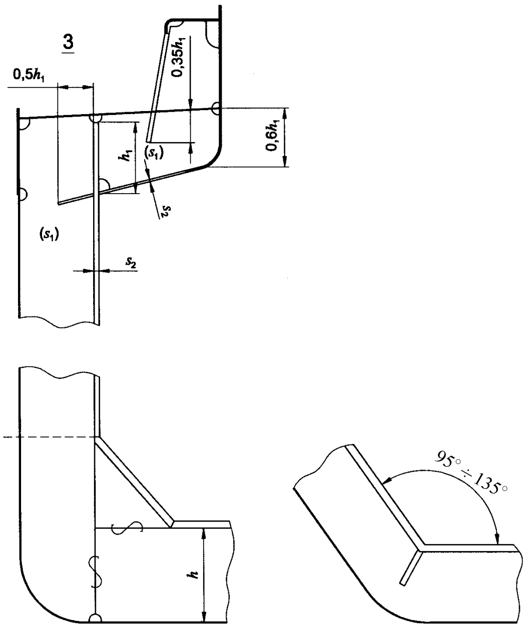


Fig. 2.3.6-1 Fig. 2.3.6-2 Fig. 2.3.6-3

The section modulus of the side stringer is to be at least the 5-fold section modulus of side frames in the fore part of the ship according to 2.3.2.

2.3.7.2 Where a depth in the engine room is over 2 m, a side stringer is to be fitted about half the depth. It is to be dimensioned as web frames in the engine room.

The side stringer is to be continued beyond the fore and aft bulkheads of the engine room as transitional brackets over a length of at least two spacings.

2.3.7.3 Fuel oil tanks extended from bottom to deck and bounded by the ship's side which length exceeds one spacing are to have a side stringer at a midheight. The section modulus W, in cm^3, of such a stringer is to be not less than that determined by the following formula:

$$W = 5zhl^2 \qquad (2.3.7.3)$$

where z = fuel oil tank height, in m;
h = elevation of the air pipe end above a side stringer, in m;
l = fuel oil tank length (distance between transverse bulkheads), in m.

2.3.7.4 For side framing of alternating main frames having the section modulus reduced by 35 per cent according to 2.3.2.1, and web frames with one side stringer, the moment of inertia I_n, in cm^4, of that stringer is to be not less than that determined by the following formula:

$$I_n = 1{,}45 I_m (d/a)(a_w/D)^4 \qquad (2.3.7.4)$$

where I_m = moment of inertia of the main frame corresponding to the section modulus according to 2.3.2.1, but without reduction by 35 per cent, in cm^4.
A distance between web frames a_w is to be not greater than that specified in Table 2.3.6.1.

2.3.7.5 A side stringer in a fore end as required in 2.3.7.1 is to be joined to every second frame with a vertical bracket.

2.3.7.6 Where a side fender is welded to side plating below a sheer strake of a height according to 2.1.4.2, an intercostal side stringer welded to every frame is to be fitted in the plane of one of side fender webs.

2.4 DECKS

2.4.1 Strength deck plating.

2.4.1.1 The thickness of strength deck plating s, in mm, for a transverse framing system is to be not less than that determined by the following formulae:

.1 on cargo ships within 0,5L amidships or within cargo holds:

$$s = 3k\sqrt{L}\,\sqrt[3]{(a^2 d/D)(1 - l_c/L)(2{,}34c_b^4 - 1)} \qquad (2.4.1.1.1)$$

where k = 1 – for a loading sequence "B";
$k = 1{,}34\sqrt[3]{1{,}41 - c_b}$ for a loading sequence "A";
l_c = total length of a cargo hold, in m;
c_b = block coefficient, but not less than 0,8;

.2 on passenger ships within 0,5L amidhips:

$$s = 2\sqrt[3]{L + (N - 588)/20}\ \times$$

$$\times\sqrt[3]{a^2(mc_b^3 - n)(2{,}1 - 1{,}3l_n/L)(1{,}7 - 3{,}5l_m/L)} + \Delta s \qquad (2.4.1.1.2)$$

where m, n = values adopted according to Table 2.4.1.1;
c_b = block coefficient;
l_n = length of the first tier of a superstructure, in m;
l_m = engine room length, in m;

Table 2.4.1.1

Length L	Total output P of main engines, in kW													
	220 and less		330		440		590		740		880		1100 and over	
	m	n	m	n	m	n	m	n	m	n	m	n	m	n
Up to 20 m	5,20	0,13	2,73	-0,41	2,35	-0,30	2,20	-0,32	2,20	-0,32	2,20	-0,52	2,20	-0,52
30 m	5,35	0,16	3,34	-0,28	2,80	-0,40	2,54	-0,451	2,34	-0,431	2,54	-0,431	2,30	-0,451
40 m	5,90	0,27	4,67	+0,01	3,81	-0,178	3,28	-0,291	3,03	-0,335	2,76	-0,415	2,45	-0,450
50 m	7,30	0,58	5,63	+0,223	4,77	-0,03	3,81	-0,178	3,48	-0,23	3,00	-0,352	2,50	-0,440
60 m	8,87	0,92	7,00	+0,31	6,02	-0,00	4,21	-0,09	3,75	-0,19	3,21	-0,308	2,55	-0,413

N = total specified output of main engines, in kW;
Δs = 0 – for ships in **Zones 3 — 4**, in mm;
Δs = 0,02L – for ships in **Zones 1 — 2**, in mm;

.3 on tugs within 0,5L amidships:

$$s = 1{,}8\sqrt[3]{L+6}\sqrt[3]{a^2[m(c_b-0{,}15)^3-n](1{,}7-2{,}34l_m/L)}+\Delta s \qquad (2.4.1.1.3)$$

where c_b = block coefficient;
m, n = values adopted according to Table 2.4.1.1;
l_m = engine room length, in m;
Δs = 0 – for ships in **Zones 3 — 4**, in mm;
Δs = 0,02L – for ships in **Zones 1 — 2**, in mm;

.4 on pushers over the ship's entire length:

$$s = 2{,}0\sqrt[3]{L}\sqrt[3]{a^2[m(c_b-0{,}15)^3-n](1{,}7-1{,}4l_m/L)}+\Delta s \qquad (2.4.1.1.4)$$

where c_b = block coefficient, but not less than 0,6;
m, n = values adopted according to Table 2.4.1.1;
l_m = engine room length, in m;
Δs = 0,5 – for ships in **Zones 3 — 4**, in mm;
Δs = 0,02(L + 30) – for ships in **Zones 1 — 2**, in mm;

.5 on industrial ships within 0,5L amidships:

$$s = 2{,}3\sqrt[3]{L+4}\sqrt[3]{a^2\,(0{,}28+0{,}8c_b)(1{,}7-1{,}75l_m/L)}+\Delta s \qquad (2.4.1.1.5)$$

where l_m = engine room length, in m;
Δs = 0,5 – for ships in **Zones 3 — 4**, in mm;
Δs = 0,02(L +30) – for ships in **Zones 1 — 2**, in mm.

2.4.1.2 Thicknesses of plating for a longitudinal deck framing system determined by the formulae of 2.4.1.1 may be reduced by 35 per cent. In this case, the value a in the formulae is assumed equal to the underdeck longitudinals spacing.

2.4.1.3 Thickness of deck plating s amidships for any framing system is to be, however, not less than that determined by the following formula:

$$s = k\sqrt{L}\text{, in mm} \qquad (2.4.1.3\text{-}1)$$

where k = 0,7 for cargo ships, tugs and industrial ships;
k = 0,6 for passenger ships,

but at least 3 mm, and for tankers, at least 5 mm.

The thickness of deck plating s of pushers over the entire deck length is to be not less than that determined by the following formula:

$$s = 0{,}7\sqrt{L+30}\text{, in mm.} \qquad (2.4.1.3\text{-}2)$$

2.4.1.4 In case of deck openings over 0,2B the deck plating thickness according to 2.4.1.1 and 2.4.1.2 is to be increased in way of openings proportionally to a value:

$$\sqrt[3]{0{,}8B/(B-C)} \qquad (2.4.1.4)$$

where c = deck opening width, in m.

The increase of plates thickness may be replaced by the arrangement of longitudinal reinforcements or coamings of a length of at least twofold that of an opening or 2D whichever is less.

2.4.1.5 The deck plating thickness as required amidships may gradually reduce towards the ship's ends down to the thickness according to 2.4.1.3.

2.4.1.6 If the ship has a superstructure involved in longitudinal bending of the ship's hull and its design meets the requirements of 2.12, the strength deck plating thickness is adopted according to 2.4.1.3.

2.4.2 Deck stringer of a strength deck.

2.4.2.1 The width of a deck stringer b, in mm, over the ship's entire length, except its peaks, is to be not less than that determined by the following formula:

$$b = 300 + 5L. \qquad (2.4.2.1\text{-}1)$$

The thickness of the deck stringer s, in mm, amidships within 0,7L on cargo ships, 1,0L on pushers and 0,5L on other ships is to be not less than that determined by the following formula:

$$s = k\sqrt{L} \qquad (2.4.2.1\text{-}2)$$

where k = 1 – for cargo ships and industrial ships;
k = 0,8 – for passenger ships, tugs and pushers.

In the ship's ends, except pushers, the thickness of the deck stringer may be reduced by 20 per cent.

The thickness of the deck stringer is to be not less than that of deck plating according to 2.4.1.

2.4.2.2 The width of the deck stringer within an aft superstructure on non-self-propelled ships and near a forward superstructure on self-propelled and non-self-propelled ships may be reduced by 30 per cent. The deck stringer width on self-propelled cargo ships is not to be reduced within the aft superstructure. In all cases and over the entire ship's length the deck stringer width is to be sufficient to ensure a free passage 400 mm wide.

2.4.2.3 A thickened plate of deck plating is to be arranged in corners of openings of the aft end of an outer cargo hatch, and/or of the forward wall of a recessed aft superstructure. The forward and aft edges of the thickened plate are to be at a distance of at least 2,5 spacings away from the opening corners. Compared with the deck plating thickness, the thickened plate is to have the one increased by 40 per cent for ships with loading sequence "A" and by 25 per cent, with loading sequence "B".

2.4.3 Deck openings.

2.4.3.1 Where openings in a deck stringer over 0,15 of its width in diameter are made, the cross-section area lost is to be compensated by the thickening of the deck stringer plate.

Under no circumstances is the diameter of round openings in the deck stringer to exceed half the deck stringer width.

2.4.3.2 Openings over 6a long and over $0{,}8B$ wide in deck plating amidships and before the aft engine room are to have corners rounded on a radius of at least 0,1 of the opening width; the openings outside the above area, 0,05 of the opening width. The remaining openings are to be rounded on a radius equal to at least the 5-fold thickness of deck plating.

2.5 DECK FRAMING

2.5.1 Arrangement of deck framing members.

2.5.1.1 Deep beams or beams in transverse deck framing are to be arranged in the planes of transverse side framing (frames). The beams are not required only in the planes of intermediate frames in the fore part of the ship.

2.5.1.2 A distance between underdeck longitudinals in longitudinal deck framing is not to exceed 0,60 m, and between deep beams, 2,4 m. The longitudinal deck framing may be used in all the ship's compartments.

2.5.2 Beams.

2.5.2.1 The section modulus of beams W, in cm^3, is to be not less than that determined by the following formula:

$$W = 0{,}6apl^2 \qquad (2.5.2.1\text{-}1)$$

where l = beam span including end brackets, in m.
Beam supports are considered the ship's sides, longitudinal bulkheads, inner sides, carlings designed according to 2.5.5 and pillars, according to 2.5.6. The beam support is also considered a coaming designed according to 2.6.1. The value of l is not to be assumed less than:

$$l_{min} = B/6 + 1. \qquad (2.5.2.1\text{-}2)$$

For ships having a breadth $3{,}0\text{ m} < B \leqslant 4{,}5$ m the beam span is to be assumed without regard for carlings as supports;

p = deck loading assumed equal to:
7 kPa – for cargo ships decks;
5 kPa – for strength decks of other types of ships;
3,5 kPa – for enclosed accommodation decks other than strength decks;
2 kPa – for superstructure decks inaccessible for passengers.

2.5.2.2 The section modulus of beams aft from the aft bulkhead of a cargo hold on self-propelled cargo ships with the output N, in kW, to load capacity, in tons, ratio over 0,44, is to be increased by 30 per cent as compared with the value specified in 2.5.2.1.

2.5.2.3 Attachment of beams ends.

Beams are to be attached to frames, longitudinal bulkhead stiffeners, and superstructure bulkhead stiffeners and to carlings with the brackets made according to 1.3.4.

Continuous beams running through webs of carlings or other members are to be joined to them in accordance with 1.3.2.1.

2.5.2.4 Beams in frame plane.

On dry cargo ships, where a distance between the ship's side and the coaming does not exceed 1 m frames are to be joined to the underdeck part of the cargo hatch coaming within the cargo hatch length by means of beams having a thickness of at least $s = 0{,}75\sqrt{L}$, in mm, a depth at frames $h = 0{,}12D$, in m, and at the coaming $h = 0{,}06D$, in m, a flange width of at least a ten-fold beam thickness (refer to Fig. 2.3.3.1).

Where the above distance is over 1 m, beams are to be joined to frames with brackets.

2.5.3 Underdeck longitudinals.

2.5.3.1 The section modulus of underdeck longitudinals W, in cm^3, is to be not less than that determined by the following formulae:

for cargo ships within the cargo holds length:

in a loading sequence "A"

$$W = a(p + L/10)l^2; \qquad (2.5.3.1\text{-}1)$$

in a loading sequence "B"

$$W = a(p + L/14)l^2; \qquad (2.5.3.1\text{-}2)$$

for other types of ships amidships

$$W = a(p + L/20)l^2 \qquad (2.5.3.1\text{-}3)$$

where a = underdeck longitudinals spacing, in m;
p = deck loading according to 2.5.2.1, in kPa;
l = underdeck longitudinal span, end restraints inclusive, in m. Underdeck longitudinal supports are considered transverse bulkheads and deep beams.

The value of a section modulus for underdeck longitudinals outside the cargo hold may be determined without regard for the ship's length effect.

The flexibility of underdeck longitudinals is to meet the following condition:

$$\lambda = 100l/\sqrt{I_v/f_e} \leqslant 70 \qquad (2.5.3.1\text{-}4)$$

where f_e = cross-sectional area of underdeck longitudinals with due regard for an effective flange, in cm^2;
I_v = moment of inertia of longitudinals with an effective flange, in cm^4. Effective flange area $f_{ef} = as$.

2.5.3.2 Underdeck longitudinals are to be continuous between transverse bulkheads. They are to be joined to deep beams according to 1.3.2.1.

2.5.3.3 Ends of underdeck longitudinals discontinued at transverse bulkheads are to be joined to the bulkhead or its vertical stiffeners with brackets dimensioned according to 1.3.4.

A distance from longitudinal ends to the plate of bulkhead plating is to be not greater than 20 mm.

Longitudinals are to be attached to horizontally-framed bulkheads according to Fig. 2.2.3.9.

2.5.4 Deep beams.

2.5.4.1 Deep beams are to be arranged in the planes of web frames designed according to 2.3.6 and in the planes of transverse coamings of cargo hatches, engine room trunks and other large deck openings unless the equivalent deck reinforcement at the opening is provided.

2.5.4.2 The section modulus of deep beams in transverse deck framing is to be equal to that of web frames to which the deep beams are attached.

In selecting deep beams being attached to web frames reinforced according to 3.4.1, the reinforcement may be ignored.

2.5.4.3 The section modulus of deep beams W, in cm^3, in longitudinal deck framing within the cargo hold length for cargo ships and amidships for other types of ships is to be not less than that determined by the following formula:

$$W = 0{,}8a_w(p + L/40)l^2 \qquad (2.5.4.3)$$

where a_w = web spacing, in m;
p = deck loading according to 2.5.2.1, in kPa;
l = deep beam span, in m.

The value of a section modulus for deep beams outside the length range specified may be determined without due regard for the ship's length effect.

2.5.4.4 Deep beams are to have the same design as web frames, which they are attached to. Where a longitudinal framing system is used, deep beams are to be made of a T-section.

2.5.4.5 A deep beam is to be joined to a web frame in accordance with Figs. 2.3.6-1 to 2.3.6-3.

2.5.5 Carlings.

2.5.5.1 Carlings are to be fitted in those places where the length of a beam span is over $0{,}5B$. In this case it is recommended to fit them in the plane of bottom stringers using pillars for their connection.

Carlings are not necessary for the ships having a breadth $B < 3$ m. A carling is to be fitted in the central plane of the ship having a breadth $3{,}0 \text{ m} \leqslant B \leqslant 4{,}5$ m.

Carlings are to be extended to the ship's ends as far as possible.

2.5.5.2 The section modulus of carlings W, in cm^3, is to be not less than that determined by the following formula:

$$W = kpbl^2 \qquad (2.5.5.2)$$

where p = deck loading according to 2.5.2.1, in kPa;
b = width measured between the middles of non-stiffened deck areas on both sides of the carling, in m;
l = carling span, in m. Carling supports are considered transverse bulkheads and deep beams if they are supported in the place of their intersection by pillars;
k = 0,66 – for carlings with bracketed ends or continued at least within two spacings behind a support;
k = 0,74 – for carlings without bracketed ends or not continued within two spacings behind a support.

The section modulus of carlings for the ships having a breadth $3{,}0 \text{ m} \leqslant B \leqslant 4{,}5$ m is to be not less than that of beams.

2.5.5.3 Where a carling has several spans of a different cross-section, a transition from a greater value to a lesser one is to be gradual within 1/4 of the lesser span length.

2.5.5.4 Brackets for carling ends embedment are to have the length of a free edge equal to the carling depth, a thickness equal to the web thickness, and a face plate dimensioned as the carling face plate.

2.5.5.5 A carling is to be joined to, at least, every fourth beam with a vertical bracket; where a pillar is fitted, the carling is to be joined to the relevant beam with two vertical brackets as shown in Fig. 2.5.5.5.

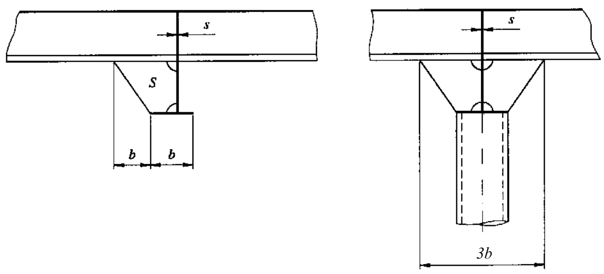


Fig. 2.5.5.5

2.5.6 Pillars.

2.5.6.1 Pillars are to be fitted in those places where large local loads cannot be carried by bulkheads or carlings and where the span of bottom and deck members is to be reduced.

2.5.6.2 Pillars inside the superstructure are, as far as possible, to be arranged directly above the pillar inside the ship's hull. Where such an arrangement is impossible, a deep beam or carling is to be fitted between upper and lower pillars.

Pillars inside the ship's hull are to be carried by bottom framing. Where a pillar is fitted between floors, an extra member or bracket is to be arranged between adjacent floors. With large support forces under a pillar, a longitudinal stringer is to be fitted to distribute the support force between several floors.

Where a pillar bears against a solid floor or a bottom stringer within a span, their webs are reinforced according to Fig. 2.5.6.2.

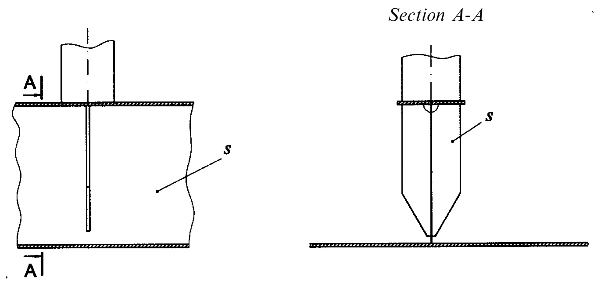


Fig. 2.5.6.2

2.5.6.3 The cross-sectional area of a pillar f, in cm^2, is to be not less than that determined by the following formula:

$$f = N + \sqrt{1{,}28 \cdot 10^{-3} + 1{,}35 N l_1^2} \quad (2.5.6.3\text{-}1)$$

where l_1 = pillar length including the end attachment, in m;
N = pillar loading, in kN, determined by the following formula:

$$N = blp + \sum_i (blp)_i + q \quad (2.5.6.3\text{-}2)$$

where l = average length of the area of a deck supported by the pillar (distance between adjacent pillars over the ship's length), in m;
b = average width of the area of a deck supported by the pillar (distance between adjacent pillars over the ship's breadth), in m;
p = deck loading according to 2.5.2.1, in kPa;
q = loading from the mass of arrangements, machinery, etc. acting on the pillar in question increased by 25 per cent, in kN;
$\sum_i (blp)_i$ = sum of loadings from above-arranged pillars acting on the pillar in question, in kN.

2.5.6.4 The outside diameter of tubular pillars d_2, in mm, is to be not less than that determined by the following formula:

$$d_2 = \sqrt{4{,}6N + \sqrt{21N^2 + 9Nd_1^2 + d_1^4 + 2{,}18Nl_1^2 \cdot 10^4}} \quad (2.5.6.4\text{-}1)$$

where for N, l_1 = refer to 2.5.6.3;
d_1 = inside diameter of a tubular pillar, in mm; as the first approximation, d_1 may be assumed equal to $d_1 = 1{,}55d - 15$ mm,
where d = diameter of a solid pillar of circular section determined according to 2.5.6.3, in mm.

Pillars of composite sections or in sections are to have a cross-sectional area and flexibility equivalent to those of tubular pillars. The pillar flexibility is determined by the following formula:

$$\lambda = l_1 / \sqrt{I/f} \quad (2.5.6.4\text{-}2)$$

where l_1 = pillar length, in cm;
I = least moment of inertia of a cross-section, in cm4;
f = cross-sectional area, in cm^2.

2.5.6.5 Hollow pillars whose damage in cargo operations may be expected, are to have the wall thickness of at least 5 mm.

Hollow pillars are not to be fitted in cargo and fuel oil tanks.

2.6 COAMINGS OF DECK OPENINGS

2.6.1 Openings for cargo hatches are to be protected around their perimeter with coamings. The structural design of the coaming is to protect the inside edge of a deck opening against damage by cargo gear.

The coaming height is generally to be not greater than 90 thicknesses of the coaming web. With the greater height of the coaming, a horizontal stiffener with thickness and width assumed equal to those of vertical stiffeners at their midheight according to 2.6.2.3, is to be fitted at the mid-height of the coaming web.

2.6.2 Longitudinal coamings.

2.6.2.1 Longitudinal coamings bounding deck openings or cargo hatches may be designed:

continuous and having a length of at least $4D$ stiffened according to 2.6.2.2 and 2.6.2.3, involved in the longitudinal bending of the ship's hull;

short and having a length less than $4D$, not involved in the longitudinal bending of the ship's hull and providing the safety of people only. Such coamings consist of a plate and reinforcement of its top edge.

2.6.2.2 The plate of the longitudinal continuous coaming web is to have a thickness equal to that of an adjacent deck stringer according to 2.4.2. The flange of a coaming top edge made in a section appropriate to the design adopted for the storage of hatch covers or for their movement is to have the cross-sectional area f, in cm^2, not less that that determined by the following formula:

$$f = sh_0/20 \quad (2.6.2.2\text{-}1)$$

where s = coaming web thickness, in mm;
h_0 = coaming height, in cm, measured from the deck to the lower surface of the horizontal stiffener, but not greater than 60 cm.

The section modulus of the cross section of the coaming flange about the vertical axis W, in cm^3, with due regard for an effective flange of $25s$ wide is to be not less than:

$$W = 2s^2 \quad (2.6.2.2\text{-}2)$$

where s = coaming web thickness, in mm.

The coaming flange is to be fitted closer to the top edge of the coaming web and welded on to it with a continuous double weld.

It is recommended to avoid openings in the coamings webs. Where such openings are necessary, they are to have their edges rounded. A reduced area in the section having an opening is to be compensated by the increased thickness of the coaming web or by another structural approach.

2.6.2.3 The coaming is to be reinforced with vertical stiffeners welded on by a double weld to the coaming flange and web, as well as to a deck in way of beams arrangement. A distance between these stiffeners is not to be over 4 spacings, and their depth at the coaming midheight is to be not less than that determined by the following formula:

$$h = 10s + 80, \text{ mm} \qquad (2.6.2.3)$$

where s = coaming thickness, in mm.

2.6.2.4 Longitudinal coamings under $4D$ long not involved in the ship's longitudinal bending are to have the section modulus about a horizontal axis W, in cm^3, not less than that determined by the following formula:

$$W = kpl^2(B + b) \qquad (2.6.2.4)$$

where k = 0,19 – for hatch corners supported by pillars;
k = 0,14 – for longitudinal coamings joined to transverse coamings running over the entire width of an opening without pillars support;
p = mean loading on deck and hatch covers, but not less than 4 kPa;
l, b = hatch length and width, in m.

Where longitudinal coamings under $4D$ long are continued like carlings to transverse bulkheads, and transverse coamings are joined to them without the use of pillars, then $k = 0{,}19$ and l is assumed equal to transverse bulkheads spacing.

The thickness of web plates for coamings under $4D$ long is to be equal to that of deck plating.

2.6.3 Transverse coamings.

2.6.3.1 Thickness of web plates for transverse coamings is to be equal to that of web plates for longitudinal coamings to which they are joined.

Where transverse coamings are joined to longitudinal coamings without the use of pillars, their section modulus about a horizontal axis W, in cm^3, is to be not less than that determined by the following formula:

$$W = 0{,}2pbl(3B - 2b^2/B) \qquad (2.6.3.1)$$

where for p, b, l = refer to 2.6.2.4.

2.6.3.2 The top edge of cargo hatch coamings is to be stiffened by a horizontal bar connected to a deck and coaming plate by means of vertical stiffeners spaced not more than 2,4 m apart, or in another equivalent way. The width of the cross-sectional area of stiffeners is to be at least 1/6 of the coaming height above the deck, and the thickness is to be equal to that of the coaming plate.

2.7 BULKHEADS

2.7.1 Bulkheads arrangement.

2.7.1.1 A collision bulkhead is to be installed so that the following requirements are complied with:

.1 a collision bulkhead is to be installed on all ships extended from the ship's bottom to the upper deck, or where there is no upper deck, up to the gunwale.

The distance between the collision bulkhead and the forward perpendicular is to be between $0{,}04L$ and $0{,}04L + 2$ m;

.2 a collision bulkhead is to be installed at a suitable distance from the bow in such a way that the buoyancy of the laden ship is ensured, with a residual safety clearance of 100 mm if water enters the watertight compartment ahead of the collision bulkhead (refer to the definition of the "Residual safety clearance" in 1.2.1, Part IV "Stability, Subdivision and Freeboard");

.3 the requirement of 2.7.1.1.2 may not be taken into consideration if the collision bulkhead is installed at a distance of $0{,}04L + 2$ m from the forward perpendicular in the plane of maximum draught.

The distance from the collision bulkhead to the forward perpendicular may be reduced to $0{,}03L$. In that case the requirement referred to in 2.7.1.1.2 is to be proved by calculation on the assumption that the compartment ahead of the collision bulkhead and those adjacent have all been filled with water.

2.7.1.2 A transverse afterpeak bulkhead extended from the ship's bottom to the upper deck is to be fitted on all ships having a length of 15 m and over or, where there is no deck, up to the gunwale.

Distance from the afterepeak bulkhead to the aft perpendicular shall be at least 0,04L but not less than 1,4 m.

2.7.1.3 On self-propelled ships and non-self-propelled ships with machinery inside the ship's hull, the engine room is to be bounded by watertight bulkheads. Where the engine room is arranged aft, the aft watertight bulkhead specified in 2.7.1.2 may be considered as an aft bulkhead bounding the engine room.

Accommodation spaces with the deck below the load waterline level are to be bounded by watertight bulkheads.

Watertight bulkheads are to be arranged at ends of cargo compartments.

Accommodation spaces are to be separated from engine rooms, boiler rooms and holds by gastight bulkheads and are to be directly accessible from the deck. If no such access has been provided an emergency exit is to be provided leading directly to the deck.

2.7.1.4 On dry cargo ships, the total minimum number of tight transverse bulkheads, including the forepeak and afterpeak ones, is to be:

3 — for ships having a length of 20 m — 60 m;
4 — for ships having a length of 61 m — 80 m;
5 — for ships having a length of 81 m — 100 m;
6 — for ships having a length of 101 m and over.

2.7.1.5 All transverse tight bulkheads are to extend from the ship's bottom to the freeboard deck.

2.7.1.6 No doors and access holes are allowed in the forepeak and afterpeak bulkheads. Where doors and access holes are fitted in other transverse tight bulkheads, they are to be tight and closed on both sides.

2.7.1.7 All pipes, cables and moving parts of steering ropes and shafts penetrating tight bulkheads are to be laid in bulkhead sockets using stuffing boxes or other devices, which design ensures the bulkhead tightness.

2.7.1.8 On ships with double bottom and double sides, transverse bulkheads within cargo hold may be omitted.

In this case, tight bulkheads are to be fitted in a double-hull space with an interval of not more than 20 m. Thickness of tight bulkheads is to be equal to that of solid floors and their framing is to meet the requirements of 2.7.3.

2.7.1.9 On passenger ships the number and position of bulkheads are to be selected such that, in the event of flooding, the ship remains buoyant according to 3.1.14, Part IV "Stability, Subdivision and Freeboard". The bulkheads are to be watertight and be installed up to the bulkhead deck. Where there is no bulkhead deck, these bulkheads are to extend to a height at least 200 mm above the margin line.

Bulkheads separating the engine rooms from passenger areas or crew and shipboard personnel accommodation are to have no doors.

Collision bulkheads on passenger ships are to have no openings and no doors.

Transverse bulkheads may be fitted with bulkhead recesses, if all parts of the recesses lie within the safe area.

The number of openings in the bulkheads is to be kept as low as is consistent with the type of construction and normal operation of the ship.

2.7.2 Plates of bulkhead plating.

2.7.2.1 The plate thickness for bulkhead plating s, in mm, is to be not less than that determined by the following formula:

$$s = 0{,}9az + k \qquad (2.7.2.1)$$

where a = spacing of bulkhead stiffeners, in m;
z = height measured in the ship's central plane from the lower edge of the bulkhead plate in question to the upper deck, and for cargo ships, to the top edge of a hatch coaming, but not less than 1 m;
k = 3,5 – for a forepeak bulkhead;
k = 2,8 – for remaining watertight bulkheads.

2.7.2.2 The thickness of the bulkhead plating strake adjacent to bottom plating on cargo ships is to be increased by 1 mm as compared with that specified in 2.7.2.1.

The strake width is to exceed the top edge of bottom framing by at least 100 mm.

2.7.2.3 In the engine room, the bulkhead plating strake, adjacent to the bottom, to which main engines foundations are attached, is to have a height of at least $0{,}1B$ with the top edge of the strake by at least 100 mm above the foundations level.

The thickness of this strake plates s_m, in mm, is to be not less than that determined by the following formula:

$$s_m = s(1 + 20{,}4N/Ln) \qquad (2.7.2.3)$$

where s = thickness of plates of the engine room bulkhead plating according to 2.7.2.1;
N = specified output of a main engine;
n = number of revolutions of the main engine, in rpm.

2.7.2.4 The thickness of the horizontal part plate-bulkhead plating step (platform) is to be by 1 mm greater than the plate thickness according to 2.7.2.1 at the height measured to the level of the bulkhead plating step (platform).

2.7.3 Bulkhead stiffeners.

2.7.3.1 Bulkhead stiffeners spacing is not to exceed 0,5 m for a forepeak bulkhead and 0,6 m for other bulkheads. Vertical stiffeners of a bulkhead in longitudinal bottom or deck framing are to be arranged in the planes of longitudinal bottom or underdeck members.

2.7.3.2 The section modulus of bulkhead stiffeners W, in cm^3, with scarfed ends is to be not less than that determined by the following formula:

$$W = kazl^2 + 3 \qquad (2.7.3.2)$$

where k = factor equal to:
5 – for forepeak bulkheads;
4 – for watertight bulkheads of cargo compartments;
3 – for cargo hold bulkheads;
z = for the vertical stiffener of a bulkhead:
height measured from the stiffener midlength to the upper deck, and for cargo ships, to the top edge of the hatch coaming, in m;
for the horizontal member of a bulkhead:
height measured form the member to the upper deck, and for cargo ships, to the top edge of the hatch coaming, in m;
l = largest stiffener span between supports, in m;
a = bulkhead stiffeners spacing, in m.

When bulkhead stiffener ends are anchored with knees, the stiffener section modulus determined by the Formula (2.7.3.2) may be reduced by 25 per cent.

2.7.3.3 The section modulus of stiffeners at the horizontal part of the bulkhead step (platform) is to be increased by 35 per cent as compared with that specified in 2.7.3.2. It is, at least, to meet the requirements for deck framing given in 2.5.

2.7.3.4 The section modulus of bulkhead stiffeners arranged in the plane of bottom stringers and carlings, as well as above the members of main engines foundations is to be increased by 100 per cent as compared with that specified in 2.7.3.2.

2.7.3.5 Free ends of stiffeners scarfed are to be above bottom and deck plating not more than by 20 mm; in this case, they are to be beveled and welded on in accordance with the requirements of 1.3.2.2 and 1.4.4.1.

With transverse deck and bottom framing when brackets are used to join bulkhead stiffener ends to bottom and deck framing members, the size of the vertical side of the bracket is to be equal to the twofold depth of the stiffener section, and the horizontal size of the bracket side is to be such that the bracket reaches an adjacent beam or floor as shown in Fig. 2.7.3.5-1.

With longitudinal deck and bottom framing brackets are to be designed as shown in Fig. 2.7.3.5-2.

2.7.4 Upper member of the bulkhead.

Where the upper edge of the bulkhead is not joined to deck plating, it is to be stiffened by a horizontal

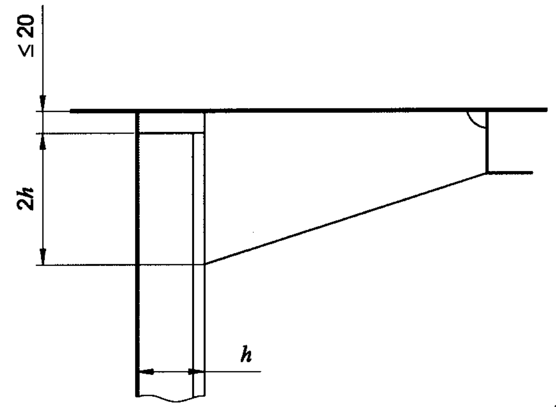


Fig. 2.7.3.5-1

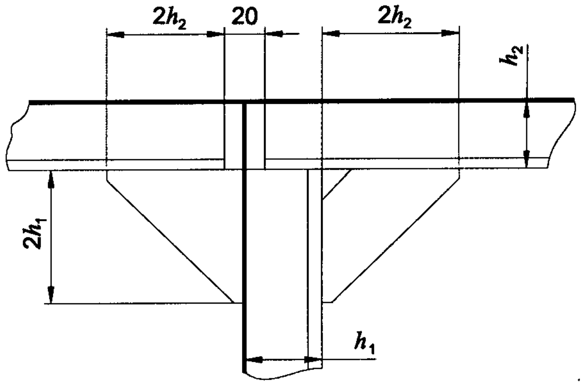


Fig. 2.7.3.5-2

member whose section modulus W, in cm^3, about a vertical axis is to be not less than that determined by the following formula:

$$W = 2h^2 l^2 \qquad (2.7.4)$$

where h = bulkhead height in the ship's central plane, in m;
l = horizontal member span including end brackets, in m.

The way of member ends fixing is to ensure the rigid attachment of ends.

The structures, the upper bulkhead member (e.g. the hatch coaming) is attached to, are to be properly reinforced.

2.7.5 Corrugated bulkheads.

2.7.5.1 The thickness of bulkhead plating plate is determined according to 2.7.2; the stiffener spacing a is assumed equal to the greatest of values of b and f shown in Fig. 2.7.5.1.

2.7.5.2 The required section modulus of a trapezoidal corrugation W, in cm^3, (refer to Fig. 2.7.5.1) is to be not less than that determined by the following formula:

$$W = kezl^2(b/80s)^2 \qquad (2.7.5.2\text{-}1)$$

where k = factor equal to:
15 — for forepeak and afterpeak bulkheads;
12 — for watertight bulkheads;
9 — for cargo hold bulkheads;

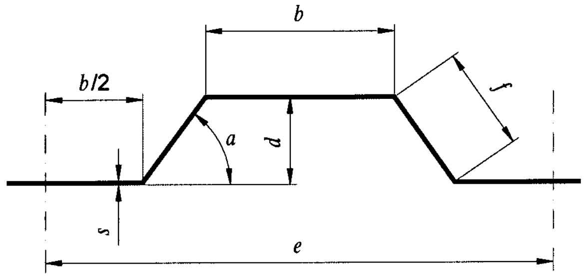


Fig. 2.7.5.1

z = height, in m, measured from the middle of a height l to the bulkhead deck, and for cargo ships, to the upper edge of a hatches coaming, but not less than 1 m;
for e, b, s = refer to Fig. 2.7.5.1, in cm;
l = bulkhead height, in m.

In calculations by the Formula (2.7.5.2-1) the ratio b/s is not to be assumed over 46, and an angle α is not to be less than 45°.

The section modulus of a trapezoidal corrugation W, in cm^3, (Fig. 2.7.5.1) is determined by the following formula:

$$W = sd(b + f/3), \qquad (2.7.5.2\text{-}2)$$

where for s, d, b, f = refer to Fig. 2.7.5.1, in cm.

The corrugations of other shapes are to be as strong as those shown in Fig. 2.7.5.1.

2.8 TANKS

2.8.1 Compartments extended from side to side and intended for liquid cargoes are to be divided into separate tanks by at least one longitudinal tight bulkhead fitted in the ship's central plane.

The strength of watertight bulkheads required in 2.7.1 and bounding the tanks is to meet the requirements of 2.7.

2.8.2 The plating thickness for vertical tank bulkheads s, in mm, is not to be less than that determined by the following formula:

$$s = 4{,}3a\sqrt{z} + 1 \qquad (2.8.2)$$

where a = stiffeners spacing, in m;
z = height measured from the upper edge of a bulkhead to the air pipe end, in m, but not less than 1 m,

but not less than 4 mm.

The plate thickness for plating of decks (platforms) bounding tanks is to be increased by 1 mm as compared with the value determined by Formula (2.8.2) at a height h measured from the horizontal bulkhead (platform) level to the air pipe end.

2.8.3 The section modulus of vertical stiffeners of tanks (independent tanks inclusive) bulkheads W, in cm^3, is to be not less than that determined by the following formula:

$$W = kaz'l^2 + m \qquad (2.8.3)$$

where k = 4,0 — for attachment of stiffener ends with brackets;
k = 5,6 — for bracketless attachment of stiffener ends;
a = stiffeners spacing, in m;
z' = height measured from the stiffener mid span to the drain pipe end, but at least 1 m;
l = stiffener span including end attachments, in m;
m = 3 — for tanks specified in 2.8.1;
m = 2 — for independent tanks.

2.8.4 Scantlings of carlings arranged under the deck being the top of a tank are determined according to the requirements of 2.5.5.2 where the height z specified in 2.8.1.2, but at least 1 m, is assumed as the deck loading p.

2.8.5 The framing of the deck bounding a tank is to be determined according to the requirements of 2.5 with the deck loading p assumed as the height of an air pipe above the tank deck, but at least 1 m.

2.8.6 For the ship's hull frames in way of fuel oil and water tanks — refer to 2.3.2.3.

2.8.7 For side stringers in fuel oil tanks — refer to 2.3.7.3.

2.8.8 Brackets anchoring stiffener ends are to meet the requirements of 1.3.4. They are to reach therewith the nearest beam, floor, frame or another transverse member.

2.8.9 The inside tank framing is to be welded on to bulkhead plating plates with a continuous double weld, or scalloped framing is to be used.

2.9 STRUCTURE OF DOUBLE BOTTOM AND DOUBLE SIDE IN WAY OF CARGO HOLD

2.9.1 Double bottom.

2.9.1.1 Where the double bottom is provided, it is to be designed as the watertight part of the ship's hull.

2.9.1.2 A possibility to monitor the presence of water in the double bottom and its pumping-out, including the ship's loading condition at the maximum loading capacity, is to be provided with any design of the inner bottom.

2.9.1.3 The depth of a double bottom is to be at least 650 mm. By agreement with the Register, the double bottom depth may be reduced.

2.9.1.4 Where the depth of the double bottom is inadequate for welding the plating from the inside, the welding procedure on the outside and calculations of local strength of double bottom structures is to be submitted to the Register for approval. The terms of including the plates of inner bottom plating, welded in this way, as an effective flange into the cross-sections of double bottom members are to be approved by the Register.

2.9.1.5 Outside the double bottom, the plates of inner bottom plating are to be extended beyond bulkheads by means of horizontal brackets, fitted at every side girder, having a length of at least $0{,}1B$ and a width of $0{,}05B$ at the bulkhead, or in other equivalent way.

2.9.1.6 Side frames are to be attached to the inner bottom plating with brackets.

2.9.2 Inner bottom plating.

The thickness of inner bottom plating s, in mm, is not to be less than that determined by the following formula:

$$s = (L/20 + 2)\,\frac{a}{0{,}5}\,. \qquad (2.9.2)$$

This thickness is to be increased by at least 3 mm where cargo handling provides for the use of grabs or other mechanized means.

2.9.3 Solid floors.

2.9.3.1 The solid floor spacing is specified in 2.2.1.1 and 2.2.1.2. If transverse system of framing is adopted, bracket floors are to be fitted between the solid floors arranged not at each frame.

2.9.3.2 For double side ships, solid floors in the double-hull space are an extension of solid floors in the double bottom and may have a varying depth reducing towards the side. The floor depth at the outer side is not to be less than the radius of a bilge rounding.

2.9.3.3 The web of a solid floor in a double bottom compartment not used as a tank, is to have a thickness s, in mm, not less than that determined by the following formula:

$$s = 0{,}60\sqrt{L}. \qquad (2.9.3.3)$$

2.9.3.4 The web of a solid floor in a double bottom compartment, used as a tank for ballasting or bunkering, is to have a thickness s, in mm, not less than that determined by the following formula:

$$s = 0{,}60\sqrt{L} + 0{,}5. \qquad (2.9.3.4)$$

2.9.3.5 The web of a solid floor in a double bottom compartment under cargo holds, where grabs are used in cargo handling, is to have a thickness s, in mm, not less than that determined by the following formula:

$$s = 0{,}60\sqrt{L} + 2{,}5. \qquad (2.9.3.5)$$

but not greater than 8 mm.

2.9.3.6 The section modulus of a solid floor is to meet the requirements of 2.2.1.3, 2.2.1.5, 2.2.1.7, 2.2.1.8 and 2.2.1.12.

Inner bottom plate, if is taken into account in calculation of the section modulus of a solid floor, is to be welded in accordance with Table 1.4.3.2 (joints Nos. 2.1 and 2.5). Welding by another way is to be subject to special consideration by the Register.

2.9.4 Bracket floors.

2.9.4.1 The ends of bottom and reverse frames of bracket floors are to overlap the brackets for a length of not less than two depths of the appropriate frame section (refer to Fig. 2.9.4.1).

2.9.4.2 The bracket thickness is not to be less than that adopted for solid floors in this region.

For the double bottom depth of 800 mm and over, the free edges of brackets are to be provided with flanges

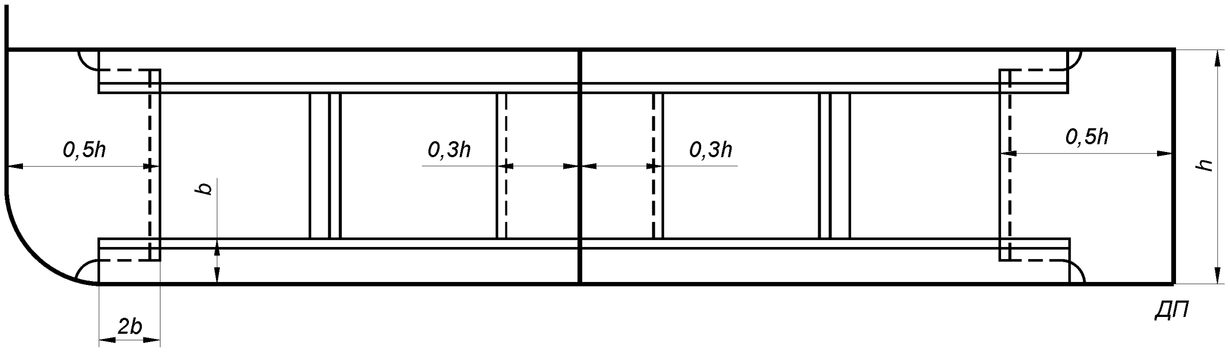


Fig. 2.9.4.1

or welded face plates 10 thicknesses wide, but not more than 90 mm.

2.9.4.3 The bracket width on either side of a central girder and at a bilge is not to be less than a half of the double bottom depth. The bracket width at a side girder is not to be less than 0,3 times the double bottom depth.

2.9.4.4 The section modulus of reverse frames of the bracket floor, in cm^3, is not to be less than that determined by Formula (2.2.2.1).

2.9.4.5 The section modulus of bottom frames of the bracket floor, in cm^3, is not to be less than that determined by Formula (2.9.6.2), where k = 7,1 and l is the frame span measured between supports but not less than B/4, in m. The supports are considered the ship's hull sides, longitudinal bulkheads, inner skins, pillars and solid side girders.

For ships where grabs are used for cargo handling, W is determined by Formula (2.9.6.6), where l is the bottom frame span of a bracket floor, in m; a is the floor spacing, in m.

2.9.4.6 Where cross ties (intermediate struts) dividing a bracket spacing in two are fitted between the brackets, the section moduli of bottom and reverse frames may be reduced by 40 per cent.

The cross-sectional area of a cross tie is not to be less than that of the lesser frame of the floor.

Where intermediate struts are fitted, brackets of side girders may be replaced by struts having the section of the bottom frame and fitted on one side of the girder.

No intermediate struts are allowed where grabs are used for cargo handling.

2.9.5 Centre girder and side girders.

2.9.5.1 The centre girder web in the centerplane is to have a thickness s, in mm, not less than that determined by the following formula:

$$s = 0{,}8\sqrt{L}. \qquad (2.9.5.1)$$

The thickness of side girders is to be equal to that of solid floors.

2.9.5.2 If longitudinal system of double bottom framing is adopted, brackets are to be fitted on each side of the centre girder at a distance not exceeding two spacings. Each of these brackets is to be extended to the nearest longitudinal or the additional side girder and welded thereto. The bracket thickness is to be equal to that of the floors. Free edges of brackets are to be provided with flange or a face plate.

2.9.5.3 The distance between a centre girder and side girder and longitudinal bulkhead or side is not to exceed 3,0 m.

The girders are to be extended as far forward and aft as practicable.

2.9.5.4 In the engine room the arrangement of side girders is to be consistent with that of the machinery seatings, so that at least one of the longitudinal girders under the seating is fitted in line with the side girder. In this case, an additional side girder is to be provided under the seating in line with the second longitudinal.

Where side girders cannot be arranged under the seatings in line with longitudinal girders, additional side girdersare are to be fitted under each longitudinal girder.

Additional side girders may be replaced by half height side girders welded to the inner bottom plating and floors only, if approved by the Register.

2.9.6 Bottom and inner bottom longitudinals.

2.9.6.1 Bottom longitudinals are to meet the requirements of 2.2.3.

2.9.6.2 Inner bottom longitudinals are to have the section modulus W, in cm^3, not less than that determined by the following formula:

$$W = kaDl^2 \qquad (2.9.6.2)$$

where k = 7,1 — for longitudinals without cross ties at mid-span between solid floors;
k = 4,25 — the same, but with cross ties;
l = longitudinal span measured between solid floors (without regard to brackets), in m.

2.9.6.3 The sectional area of a cross tie, if fitted between the bottom and inner bottom longitudinals, is not to be less than that of the lesser longitudinal to be joined.

2.9.6.4 Bottom and inner bottom longitudinals are to be continuous at non-tight floors.

2.9.6.5 Longitudinals may be cut at watertight floors. In this case, they are to be attached to the floors by the brackets having a width of 2,5 times the bottom longitudinal height.

The other ways of attachment may be also used, if approved by the Register.

2.9.6.6 On ships where grabs are used for cargo handling, the section modulus of bottom frames of the bracket floors and inner bottom longitudinals, in cm^3, is not to be less than that determined by the following formula:

$$W = 90al \qquad (2.9.6.6)$$

where a = longitudinals spacing, in m;
l = the maximum floors spacing, in m.

For a grab crane of 20 t lifting capacity, the value determined by Formula (2.9.6.6) is to be increased by 50 per cent.

2.9.7 Double bottom tanks.

The arrangement of double bottom tanks is to meet the following additional requirements:

.1 thickness of inner bottom plating above the tank is to meet the requirements of 2.8.2 for deck (platform) plating bounding the tanks;

.2 thickness of a floor or side girder bounding the tank is not to be less than that specified in 2.8.2 for vertical bulkheads bounding the tanks.

2.9.8 Bilge wells and sea chests.

Open bilge wells in the double bottom are to have a depth not greater than half the depth of the double bottom.

The thickness of floors, side girders and inner bottom plating forming the walls of sea chests and bilge wells is to be by 2 mm greater than that required by 2.9.3.4 and 2.9.2, and is to meet the requirements of 2.9.7.

2.9.9 Double side.

2.9.9.1 The breadth of a double side is not to be less than 600 mm.

2.9.9.2 The section modulus of web frames is determined for the entire cross section of the double side with due regard to the effective flange of shell and inner platings.

The section modulus of web frames is to meet the requirements of 2.3.6.4, 2.3.6.5 and 2.3.6.7.

2.9.9.3 The section modulus W, in cm^3, of struts (of both side shell and inner skin) forming the web frame is not to be less than that determined by the following formula:

$$W = 3{,}8a_pDl^2 \qquad (2.9.9.3)$$

where l = distance, as measured along the side, between the upper edge of the floor and the lower edge of the beam, in m;
a_p = web frames spacing, in m.

2.9.9.4 Struts are to be interconnected with a cross tie fitted at a mid-span or in another equivalent way.

The cross-sectional area of the cross tie f, in cm^2, is not to be less than that determined by the following formula:

$$f = 1{,}4a_pDl^2, \qquad (2.9.9.4)$$

2.9.9.5 Scantlings of frames cross section are to be determined according to the requirements of 2.3.2.

2.9.9.6 Scantlings of side longitudinals cross section are to be determined according to the requirements of 2.3.5.

2.9.9.7 Scantlings of inner skin struts are to be determined according to the requirements of 2.7.3 (where the double-hull space is a dry compartment) or 2.8.3 (for tanks).

2.9.9.8 The thickness of inner skin plating is to be equal to that of inner bottom plating as required by Formula (2.9.2).

For double-hull spaces used as tanks, the thickness of inner skin plating is to meet the requirements of 2.8.2.

2.9.9.9 The beam depth within the ship's double sides is not to be less than 0,12D, and the beam thickness – not less than $0{,}75\sqrt{L}$.

2.9.9.10 For passenger ships with a length of more than 110 m at least one of the following requirements is to be met:

.1 the ship is to have a double hull with a width of at least 800 mm;

.2 the ship is to have subdivision to ensure that, in the event of flooding of any two adjacent watertight compartments, the ship does not immerse lower than the margin line and a residual safety clearance 100 mm remains (according to Part IV "Stability, Subdivision and Freeboard").

2.10 KEELS, STEMS, STRUTS

2.10.1 Bar keel.

On self-propelled ships the bar keel of a solid rectangular cross section is to have the scantlings of the latter not less than that determined by the following formulae:

depth, in mm

$$h = 100 + L; \qquad (2.10.1\text{-}1)$$

thickness, in mm

$$s = 12 + 0{,}4L. \qquad (2.10.1\text{-}2)$$

On non-self-propelled ships the cross-sectional area of the bar keel may be reduced by 10 per cent.

On passenger ships and on industrial ships the cross-sectional area of the bar keel may be reduced by 20 per cent.

2.10.2 Stem of rolled products.

2.10.2.1 On self-propelled ships the bar stem of a solid rectangular cross section is to have the scantlings of the latter not less than that determined by the following formulae:

depth, in mm

$$h = 1{,}0L + 70; \qquad (2.10.2.1\text{-}1)$$

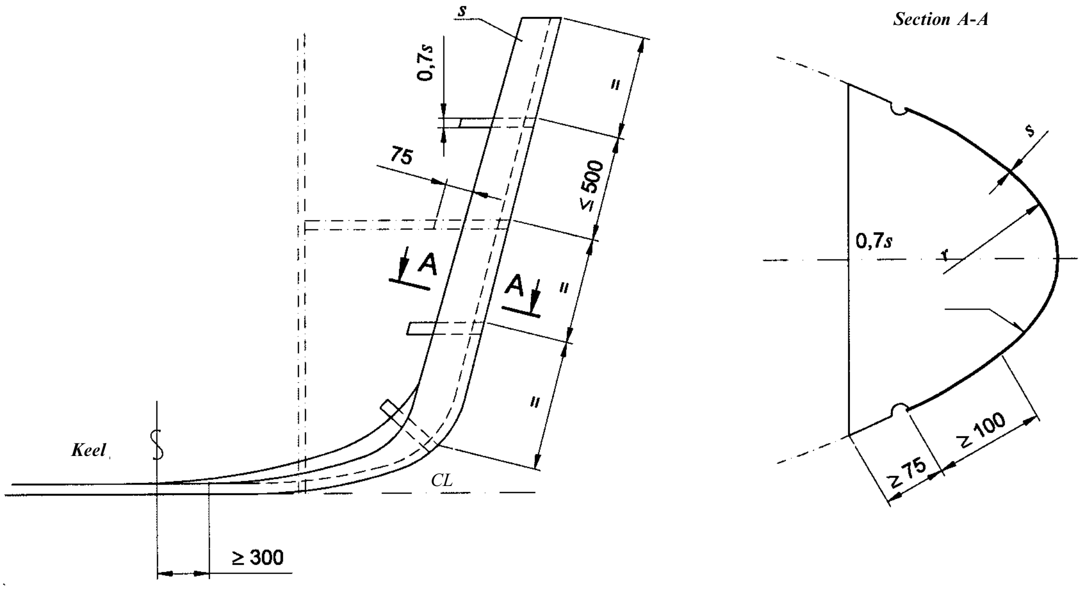


Fig. 2.10.3

thickness, in mm

$$s = 0{,}40L + 1. \qquad (2.10.2.1\text{-}2)$$

On pushers and push-tugs the depth h and thickness s are to be increased by 25 per cent.

On non-self-propelled ships the cross-sectional area of a stem may be reduced by 10 per cent.

2.10.2.2 Stems of a different cross section (e.g. of a round one), as well as cast stems are to be equivalent in strength to the bar stem.

The cast stem is to be of a simple shape and to have as large cast radii as practicable.

2.10.3 Stem of bent plates or angle bars.

2.10.3.1 Thickness of a plate s, in mm, or of the angle flange used in stem manufacture is to be not less than that determined by the following formula:

$$s = 1{,}25\sqrt{L + 2(v - 10)} \qquad (2.10.3.1)$$

where v = service speed of the ship, in km/h, but at least 11 km/h. For berth-connected ships the value of $2(v - 10)$ is assumed equal to zero.

On pushers and push-tugs the plate or angle flange thickness determined by the Formula (2.10.3.1) is to be increased by 40 per cent, but to be therewith at least 8 min.

On passenger ships and industrial ships this thickness may be reduced by 15 per cent.

On non-self-propelled ships the cross-sectional area of a stem may be reduced by 10 per cent.

2.10.3.2 The angle flange width is to be at least the 9-fold thickness required by the Formula (2.10.3.1).

The stem plate is to be extended beyond the beginning of the stem curvature for at least 100 mm (refer to Fig. 2.10.3).

The stem cross section is to be unchanged to the load waterline after which it may gradually be reduced.

2.10.3.3 The stem fabricated of sheet steel or angle bar is to be stiffened with brackets fitted not more than 500 mm apart and projecting beyond the stem boundaries for at least 75 mm. The bracket thickness is to be at least 0,7 of the stem plate thickness. Brackets are recommended to be brought to the nearest frame.

2.10.3.4 The joint of a stem and keel is to be positioned at a distance of at least 0,3 m aft from the rise of the stem outline (refer to Fig. 2.10.3).

2.10.4 Bar stern frame.

2.10.4.1 Stern frame of a single-screw ship.

The sternpost of a stern frame of bar steel is to have the section scantlings not less than that determined by the following formulae:

depth, in mm

$$h = 1{,}25L + 85; \qquad (2.10.4.1\text{-}1)$$

thickness, in mm

$$s = (0{,}40L + 10)(1 + N/883). \qquad (2.10.4.1\text{-}2)$$

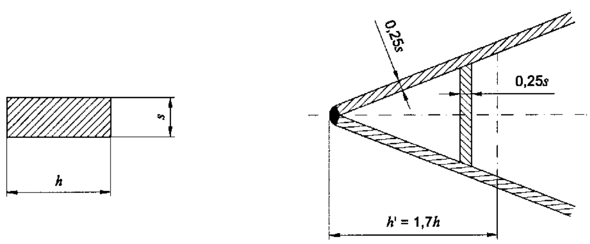


Fig. 2.10.4

If the stern frame sole does not support a rudder and is intended for propeller protection only, the sternpost thickness s, in mm, may be reduced to the value:

$$s = (0{,}40L + 10)(1 + N/1324) \qquad (2.10.4.1\text{-}3)$$

where N = the total specified output of main engines, in kW.

2.10.4.2 Stern frames of twin-screw and non-self-propelled ships.

Cross section scantlings of the rectangular stern frame which does not support the rudder are to be equal to those of the bar keel cross section of non self-propelled ships.

If the stern frame sole supports a rudder, the stern frame section depth is to be increased by 10 per cent.

2.10.5 The strength of the sternpost of bent plates is to be such that the section modulus of its cross section about the longitudinal axis is at least the 1,5-fold relevant value of the section modulus of a solid rectangular-section bar stern frame.

The design length of the cross section of a built-up stern frame h' is to be assumed not greater than $1{,}7h$ (refer to Fig. 2.10.4).

Plates thickness is to be at least 25 per cent of the bar stern frame thickness as specified in 2.10.4.1.

The strength of a cast stern frame is to be at least equal to that of a bar stern frame having a solid rectangular section according to 2.10.4.

2.10.6 A sternpost is to be attached to a transverse semi-bulkhead brought to the nearest deck, or to a deep floor joined to a deep beam with pillars.

The thickness of semi-bulkhead plates or the floor is to be at least 20 per cent of that of stern frame plates. The width of a horizontal flange along the floor top edge is to be assumed equal to the 10-fold plate thickness. The semi-bulkhead may have weight-reducing openings used as access holes in the afterpeak space.

2.10.7 Stern frame components.

2.10.7.1 The thickness of a sternpost wall (when drilled out) is to be at least 60 per cent of the sternpost thickness required by 2.10.4.1, or 35 per cent of the propeller shaft diameter, whichever is greater.

2.10.7.2 The cross section of a rudderpost is to be dimensioned like that of the sternpost designed according to the requirements of 2.10.4 and 2.10.5.

2.10.7.3 The rectangular cross section sole of a stern frame having a rudderpost, being the rudder support, is to have scantlings not less than that determined by the following formulae:

height, in mm

$$h = 1{,}65L + 75; \qquad (2.10.7.3\text{-}1)$$

thickness, in mm

$$s = 0{,}70L + 18. \qquad (2.10.7.3\text{-}2)$$

2.10.7.4 Where a stern frame has no rudderpost, the section modulus of the sole cross section W, in cm^3, about the vertical axis is to be not less than that determined by the following formula:

$$W = 0{,}75Av^2l \qquad (2.10.7.4)$$

where A = rudder blade area, in m^2;
v = the ship's maximum speed, in km/h;
l = distance of the cross section in question from the rudder rotation axis, m.

A transition from a sole to a stern frame is to be gradual.

Where the sole does not support a rudder and is intended for propeller protection only, it may be dimensioned like a bar keel. In this case the sole height is to be equal to the keel depth.

Where the stern frame sole has a cross section other than the rectangular one, the section moduli of the sole cross section adopted, about the horizontal and vertical neutral axes are to be equal to the relevant section moduli of the rectangular cross section.

In order to join a stern frame to a flat keel the lower part of the stern frame is to be extended forward from a sternpost for at least two spacings with the stern frame cross section unchanged.

2.10.8 Propeller-shaft struts.

2.10.8.1 Shaft struts may be designed as single- or two-arm ones. Two-arm strut palms are to be arranged, as possible, at an angle to one another that is different from the one between propeller blades. An angle of 90° is recommended for three- or five-bladed propellers. The angle for four-bladed ones is to be 70° or 110°. The palm axis are, as possible, to meet on the propeller shaft axis.

2.10.8.2 Scantlings of palms and a hub are determined depending on the propeller shaft diameter d and are to be equal or exceed the values specified in Table 2.10.8.2.

Table 2.10.8.2

Item	Two-arm strut		Single-arm strut
	At an angle 70° to 110°	At an angle 180°	
Palm thickness	0,45 d	0,55 d	0,75 d
Palm section area	0,5 d^2	1,1 d^2	1,5 d^2
Hub length	3,0 d	3,0 d	3,0 d
Hub wall thickness	0,35d	0,35 d	0,40 d

2.10.8.3 Palms are to penetrate the hull shell plating and to be thoroughly welded to floors or web frames. The cross-sectional area of welds is to be at least the twofold that of the palm.

The plates thickened by 50 per cent as compared with those in the ship's ends are to be used for shell plating within the strut; the plate width is to be assumed equal about 2 d, and its length is to exceed the strut palm dimensions by the propeller shaft diameter value d. Doubling plates may be used as well.

2.10.8.4 Welded shaft struts are to be equivalent in strength to cast ones.

2.11 SEATING OF MACHINERY AND BOILERS

2.11.1 Seatings of main engines.

2.11.1.1 Seating longitudinals are to be continuous over the entire length of the engine room and to be attached to its transverse bulkheads. Where they are not joined to a bottom stringer, they are to be continued as brackets beyond the engine room bulkheads for a distance of at least two spacings.

The depth of seating longitudinals depends on the engine arrangement, but it is to be at least equal to the depth of the engine room floors. The longitudinals thickness is to be by 1 mm greater than that of the floors.

Scantlings of face plates of the longitudinals on which the engine is installed are to comply with bearing surfaces of the engine; in this case the cross-sectional area of the face plate is to be at least the twofold that of the face plate of the engine room floors.

2.11.1.2 Transverse members are to meet the requirements for the engine room floors (refer also to 2.2.1.8).

2.11.2 Seatings of auxiliaries and other machinery.

2.11.2.1 Web thickness of seating longitudinals is to be equal to the thickness of floors, and the cross-sectional area of bearing face plates of seating longitudinals is to be by 50 per cent greater than the cross-sectional area of floor face plates.

2.11.2.2 The transition from the full depth of seatings to the depth of hull framing is to be gradual. The use of brackets is allowed for that purpose.

2.12 SUPERSTUCTURES AND DECKHOUSES

2.12.1 Deck plating.

2.12.1.1 The thickness of deck plating s, in mm, of a single-tier superstructure and of the first tier of multi-tier superstructures is to be not less than that determined by the following formulae:

.1 for all superstructures of ships having a length $L \leqslant 25$ m and the superstructures not taken into account while calculating the longitudinal strength of the ship's hull with the ship's length over 25 m:

$$s = (L/50 + 2)a/0,6, \qquad (2.12.1.1\text{-}1)$$

but at least 2,5 mm;

.2 for the superstructures taken into account in calculations of the longitudinal strength of the ship's hull, and for all the steps of the main deck of ships over 25 m long:

$$s_s = sD/(D_s + D) \qquad (2.12.1.1\text{-}2)$$

where s = thickness of deck plating of the strength deck according to 2.4.1;
D_s = superstructure height above the deck, in m,

but not less than the thickness s determined according to the Formula (2.12.1.1-1).

Taking into account a superstructure in calculations of the longitudinal strength of the ship's hull is defined as follows:

superstructure length is to be at least D_s, but at least $0,5L$;

superstructure is to be located amidships;

end superstructure bulkheads are to be arranged in one plane with transverse bulkheads of the hull or as close to them as possible;

web frames or vertical webs, bulkheads or semi-bulkheads fitted in the plane of deep members and bulkheads of underlying hull structures are to be provided inside superstructures. The vertical webs of end bulkheads are to be arranged in one plane with vertical webs of hull bulkheads.

2.12.1.2 The thickness of deck plating s, in mm, of the second and all the other tiers of superstructures, as well as of all the tiers of deckhouses is to be not less than that determined by the following formula:

$$s = (L/80 + 2)a/0,6, \qquad (2.12.1.2)$$

but at least 2,0 mm.

2.12.2 On ships 25 m in length and over, the tiers of superstructures and deckhouses having a length $\geqslant 0,5L$ not taken into account in calculations of the ship's longitudinal strength are not to be rigidly joined to the ship's hull, or their deck is to be divided in short sections using gaps or expansion and sliding joints. The length or such sections is not to be over 5 D_s.

2.12.3 Taking into account the second and the following tiers in calculation of the longitudinal strength of the ship's hull is to be subject to special consideration by the Register.

2.12.4 Outside walls.

2.12.4.1 The thickness of plates of outside superstructure walls plating s, in mm, taken into account in calculations of the longitudinal hull strength for ships over 25 m in length is not to be less than that determined by the following formula:

$$s = (L/40 + 2,5)a/0,6, \qquad (2.12.4.1)$$

but at least 3 mm and not greater than the deck plating thickness as required in 2.12.1.1-2.

The plates of outside superstructure walls plating in way of openings for scuttles are to be reinforced with stiffeners fitted above and below the openings and having the cross-sectional area equal to that of an opening.

For superstructures having a breadth under B, the thickness of plates of the strake joined to the upper deck is to be at least 4 mm.

2.12.4.2 For all other superstructures and deckhouses not mentioned in 2.12.4.1 the thickness of plates of outside walls plating is to be equal to that of the superstructure or deckhouse deck specified in 2.12.1.1.1 and 2.12.1.2.

The thickness of plates of the strake joined to the upper deck is to be at least 3 mm.

2.12.5 The superstructure and deckhouse deck framing is to meet the requirements of 2.5. In this case, if the superstructure is not taken into account in the calculation of the ship's longitudinal strength, the components containing the ship's length L is not to be considered in the formulae for longitudinals given in thie present Chapter.

2.12.6 Stiffeners and vertical webs of superstructure walls are to be arranged in the planes of the ship's relevant hull framing and their spacing is not to exceed 0,6 m. The section modulus of vertical members of superstructure walls (superstructure frames) of a single-tier superstructure, of the first tier of multi-tier superstructures and of main deck steps is to be 80 per cent of that of hull side frames, and for the rest superstructures and deckhouses, 60 per cent of the section modulus of side frames, but it is not to be less than 6 cm^3. Where the web frames specified in 2.12.7 are lacking in wall framing, the section modulus at least of every eighth stiffener is to be increased by 100 per cent.

2.12.7 The section modulus W, in cm^3, of web frames and deep beams of superstructures considered in calculations of the ship's longitudinal strength is to be not less than that determined by the following formula:

$$W_s = WD/(D_s + D) \tag{2.12.7}$$

where W = section modulus of web frames and deep beams of the ship's hull, in cm^3;
D_s = superstructure height above the deck, in m.

2.12.8 On ships over 25 m long the plating of longitudinal superstructure walls coinciding with the ship's sides is to be extended beyond the end bulkhead and gradually reduced to the sheer strake within the length of at least the superstructure height.

The thickness of plates of the lower strake for the plating of superstructure side walls protruding beyond its ends is to be increased by 10 per cent within the length equal to the 1,5-fold height of the superstructure.

The thickness of the sheer strake and deck stringer before the fore and behind the aft bulkheads of the superstructure is to be increased by 10 per cent within the length equal to the 2,5-fold spacing.

2.12.9 The forecastle and poop structures are considered as superstructures.

2.13 BULWARK

2.13.1 End parts of open decks are recommended to be protected with the bulwark of the height according to 10.5.1, Part III "Equipment, Arrangement and Outfit".

2.13.2 Bulwark design.

The thickness of the bulwark plate is to be equal to that of the superstructure side walls plates according to 2.12.4.1. The value of a therewith is to be assumed equal to the spacing between stays supporting the bulwark.

The spacing between bulwark supporting stays is to be not greater than 1,2 m.

The width of the lower end of a stay is to be at least 1/3 of the bulwark height.

The stays are to be arranged in the plane of beams or brackets of the upper deck.

The top edge of the bulwark is to be provided with a rail made of strip steel or steel shapes with the section modulus W, in cm^3, about a vertical axis not less than that determined by the following formula:

$$W = 5a/0,6 \tag{2.13.2}$$

where a = bulwark stays spacing, in m.

Where the components of the ship's equipment (mooring pipes and chocks) are attached to the bulwark, its stays are to be properly reinforced.

3 ADDITIONAL REQUIREMENTS FOR STRUCTURES OF SPECIAL DESIGN SHIPS

3.1 TANKERS

3.1.1 Application.

3.1.1.1 The requirements of the present Chapter apply to tankers intended for the carriage of crude oil and oil products, as well as other dangerous goods allowed for the carriage on tankers of type **N** and type **C**.

Hull structure of tankers intended for the carriage of other liquids, as well as of tankers of type **G** is subject to special consideration by the Register.

The requirements for design of the pressure cargo tanks are subject to special consideration by the Register. The strength of the pressure cargo tank structure is to be tested for a working pressure of 400 kPa according to the procedure approved by the Register.

3.1.1.2 The requirements of Sections 1, 2 and 3.2 for cargo ships under loading sequence "A", adopted in the present Part, apply to the hull structural members not defined in this Section.

3.1.1.3 Tankers as to their hull structure may be of three basic types:

tanker without double bottom and double sides, which bottom, sides, deck and bulkheads form the cargo tanks;

tanker with dry and ballast compartments in double sides and double bottom;

tanker with independent of the ship's hull fixed cargo tanks.

3.1.1.4 The present Chapter contains the requirements for a single-deck tanker, which bottom (inner bottom), sides (inner skins), deck and bulkheads form the cargo tanks.

Hull structure of tankers with independent tanks is to comply with the requirements of Section 2. The requirements of 3.1 apply to the tankers with independent tanks to the extent approved by the Register.

For the tankers intended for the carriage of dangerous goods in bulk on the Danube, the hull structure is to meet the requirements of the European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (AND).

For the tankers intended for the carriage of dangerous goods in bulk, apart from the Danube, on other European rivers, the hull structure is to meet the requirements of the Regulation for the Carriage of Dangerous Substances on the Rhine (ADNR).

3.1.2 General instructions.

3.1.2.1 Subdivision of cargo area in tanks.

3.1.2.1.1 A longitudinal watertight bulkhead is to be fitted in the ship's centerplane along the entire length of the cargo area on tankers of 6 to 12 m in breadth, as well as on the ships where length of the cargo area, including forward and aft cofferdams, exceeds $0,7L$.

On the tankers having breadth of 12 m and above, two longitudinal bulkheads, spaced not more than 0,6B apart, are to be fitted within the cargo area.

If approved by the Register, the longitudial bulkheads may be omitted or their number may be reduced, provided that a calculation demonstrates the sufficient longitudinal and transverse strength of the ship's hull and stability, including damage stability, under any loading condition of cargo in bulk.

3.1.2.1.2 The cargo area of tankers is to be divided into independent cargo tanks by transverse watertight bulkheads extended from side to side in line perpendicular to the centerplane.

The number of transverse bulkheads is to be determined on the basis of the following items:

each tank capacity is not to be more than that specified in Table 3.1.2.1.2;

Table 3.1.2.1.2

$L{\cdot}B{\cdot}D$, m^3	Maximum permissible capacity of a cargo tank, m^3
< 600	$L{\cdot}B{\cdot}D{\cdot}0{,}3$
600 — 3750	$180 + (L{\cdot}B{\cdot}D - 600){\cdot}0{,}0635$
> 3750	380

spacing between transverse bulkheads (except for the independent cylindrical tanks) is not to be more than $0,2L$, in m, or 10 m, whichever is greater.

For trunk ships, D is to be replaced by D', where

$$D' = D + (h_t{\cdot}b_t / B{\cdot}l_t / L), \qquad (3.1.2.1.2)$$

where h_t = trunk height, in m (distance between trunk deck and main deck measured on trunk side at L/2);
b_t = trunk breadth, in m;
l_t = trunk length, in m.

For cylindrical independent tanks, spacing of transverse bulkheads and tank diameter ratio is not to exceed 7.

3.1.2.2 Cofferdams, hold spaces, double-hull spaces and double bottoms.

3.1.2.2.1 Cargo tanks are to be separated from the engine room, accommodation spaces, boiler room and the ship's peaks by the cofferdams extended for not less than 600 mm.

For the tanker of type **N**, a cofferdam may be used as a service space if the latter is bounded on all sides by the waretight bulkheads extended to the bottom plating. The entrance into this space is to be provided from the deck only.

3.1.2.2.2 On the tankers designed for the carriage of oil products having a flash point 60 °C and below, cargo tanks and pump room, if the latter is arranged under the deck, are to be separated from all accommodation and service spaces by cofferdams of the same length. Cofferdams are not to be used for other purposes.

3.1.2.2.3 Independent cargo tanks and end bulkheads of the hold space are to not be less than 500 mm apart or the end bulkheads are to be of "A-60" class.

3.1.2.2.4 Pressure tanks and end bulkheads of a hold space are not to be less than 200 mm apart.

3.1.2.2.5 Hold spaces, wherein independent tanks, are fitted and cofferdams of tankers are not to be used for water ballasting.

3.1.2.2.6 Double-hull spaces and double bottoms may be filled with water ballast, provided the cargo tanks are unloaded.

If the cargo tanks are loaded, double-hull spaces and double bottoms may be filled with ballast, provided that a loading condition has been considered in the Loading Manual, the ship's stability in this loading condition has been checked and the ballast tanks are filled within 90 per cent of their total capacity.

3.1.2.2.7 Double bottom may be used for arrangement of storage tanks for fuel, provided its depth is not less than 600 mm.

3.1.2.2.8 For tanker of type **C** with integral cargo tanks, the breadth of a double-hull space is not to be less than 1,0 m.

This breadth may be reduced to 800 mm, provided the ship's hull is strengthened (in relation to the relevant Sections) as follows:

.1 the thickness of a deck stringer is to be increased by 25 per cent;

.2 the thickness of side is to plating is to be increased by 15 per cent;

.3 if the side is longitudinally framed, longitudinals are to be fitted, spaced not more than 500 mm apart, with a depth of not less than 150 mm, and the cross-section area of a face plate of not less than 7 cm^2;

.4 if the side is transversely framed, side stringers are to be fitted, spaced not more than 800 mm apart, with a depth exceeding that of frames by not less than 150 mm, and the cross-section area of a face plate of not less than 7 cm^2. Side stringers are to be welded to the frames;

.5 side stringers and side longitudinals are to be supported by the diaphragms spaced not more than 1,80 m apart.

3.1.2.2.9 For tanker of type **C** with independent cargo tanks, the breadth of a double-hull space is not to be less than 800 mm.

3.1.2.2.10 For tanker of type C with integral cargo tanks, the average depth of double bottom is to be 700 mm, but not less than 600 mm. The depth of double bottom in way of suction wells of cargo pumps may be reduced to 500 mm.

3.1.2.2.11 For tanker of type **C** with independent cargo tanks, the depth of double bottom is not to be less than 600 mm.

3.1.2.3 Superstructures and deckhouses.

3.1.2.3.1 The superstructures, wherein crew's quarters and galleys are located, are not to be arranged above the cargo tanks and vertical cofferdams.

Wheelhouse windows located not less than 1 m above the deck may be inclined in the forward direction.

3.1.2.3.2 Windows and sidescuttles in outer structures of superstructures and deckhouses facing the cargo tanks are to be of the fixed (non-opening) type.

3.1.2.3.3 Superstructures are to be made of steel.

3.1.2.4 Expansion tanks.

Every cargo tank is to be provided with an extension tank. The expansion tank capacity is to be not less than 0,5 per cent of the total cargo tank capacity. The height of the expansion tank coaming above the deck is not to be less than 300 mm, and its thickness is to be equal to that of the deck plating, but not less than 5,5 mm.

Cargo tanks may have no expansion tanks, provided the capacity and the relevant ullage (the tank top-to-cargo level distance) to compensate a heat expansion of liquid cargo en route, depending on the cargo density and the temperature variations, are specified in the Loading Manual.

3.1.3 Hull structure within cargo tanks.

3.1.3.1 Solid floors.

3.1.3.1.1 Solid floors are to be fitted on each frame where transverse system of framing is adopted and not more than on each fourth frame where longitudinal system of framing is adopted.

3.1.3.1.2 The section modulus of floors W, in cm^3, is not to be less than that determined by the following formula:

$$W = ka_1B_1^2(D + h) \qquad (3.1.3.1.2)$$

where k = factor equal to:
5,0 — for transverse or longitudinal system of bottom framing and transverse system of side framing;
3,7 — for longitudinal system of bottom and side framing;
a_1 = solid floors spacing, in m;
B_1 = 1,0B — without longitudinal bulkheads, in m;
B_1 = 0,5B — with one longitudinal bulkhead, in m;
B_1 = 0,4B — with two longitudinal bulkheads, in m;
$h = h_t + h_{ex} + 0,5$ — additional design head, in m;
h_t = trunk height, in m (distance between trunk deck and main deck);
h_{ex} = depth of expansion tank in centerplane (distance between the top edge of expansion tank and the top edge of tank), in m;
h_k = head, in m, corresponding to the setting pressure of a safety relief valve, where relevant;
for all types of tankers: $h_{ex} + 0,5 \geqslant h_k$;
for tankers of type **N**: $h_{ex} + 0,5 \geqslant 1,0$ m;
for tankers of type **C**: $h_{ex} + 0,5 \geqslant 1,5$ m.

3.1.3.1.3 Floor webs are not to be cut at the longitudinal bulkhead.

Where floor webs do not pass through the longitudinal bulkhead, they are to be attached to it by the brackets, which free edge length over the floor is to be equal to 1,5 times the floor depth, and over the bulkhead — to the floor depth. The brackets thickness is to be by 2 mm greater than that of the floor web. Floor ends and the bulkhead are not to be more than 40 mm apart.

3.1.3.1.4 Where the single bottom and longitudinal system of bottom framing are provided, if the floor span is over 4,5 m, the brackets attached to the bottom longitudinal (refer to Fig. 3.1.3.1.4) are to be fitted on both sides at the floor mid-span. Brackets may be replaced by a solid side girder.

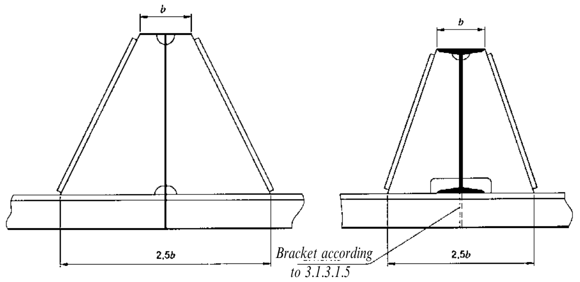


Fig. 3.1.3.1.4

3.1.3.1.5 Where the single bottom is provided, on agreement with the Register, the solid floors may be fitted across the upper edges of the bottom longitudinals (refer to Fig. 3.1.3.1.5).

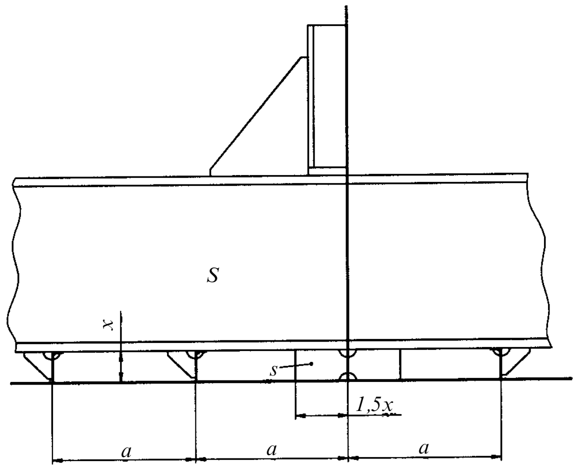


Fig. 3.1.3.1.5

In this case, floors are to be designed so that their upper and lower face plates are equal. The section modulus value of floors, as required in 3.1.3.1.2, is valid only for floors without effective flange. Where bulb profiles are used for the bottom longitudinals, their attachment to the floor is to be reinforced by brackets according to Fig. 3.1.3.1.5.

3.1.3.1.6 The thickness of the solid floor webs is to meet the requirements of 2.9.3.3 and 2.9.3.4.

3.1.3.2 Bottom and inner bottom longitudinals.

The section modulus of bottom longitudinals (where the single bottom is provided) and inner bottom longitudinals W, in cm^3, is not to be less than that determined by the following formula:

$$W = 4a(D + h + L/50)l^2 \qquad (3.1.3.2)$$

where a, l = refer to 2.2.3.3;
h = refer to 3.1.3.1.2.

Where the double bottom is provided, bottom and inner bottom longitudinals are also to meet the requirements of 2.9.6.

3.1.3.3 Centre girder and side girders.

3.1.3.3.1 Where the single bottom is provided, the centre girder and side girders are to be fitted in accordance with the requirements of 2.2.4. At that, a distance between them or between a side girder and a longitudinal bulkhead or the ship's side may be increased up to 3 m. Scantlings of the side girders are to meet the requirements of 2.2.4.5.

Where the double bottom is provided, the centre girder and side girders are to meet the requirements of 2.9.5.

3.1.3.3.2 Where bottom is longitudinally framed, the absence of side girders is subject to special consideration by the Register.

3.1.3.4 Longitudinal bulkheads terminating at the end transverse bulkheads of a cargo tank are to be extended by brackets with smooth transition into longitudinals within a cofferdam. The brackets are to be dimensioned according to Fig. 3.1.3.4.

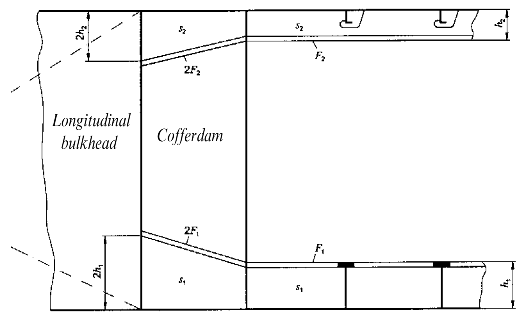


Fig. 3.1.3.4

3.1.3.5 Frames and vertical stiffeners of inner skin.

3.1.3.5.1 The section modulus of side shell frames (in the absence of inner skin) and vertical stiffeners of inner skin W, in cm^3, is not to be less than that determined by the following formula:

$$W = 2{,}5a(D + 2h)D^2 + 5 \qquad (3.1.3.5.1)$$

where h = refer to 3.1.3.1.2.

If a frame is supported by a side stringer, the section modulus obtained from Formula (3.1.3.5.1) may be reduced by 30 per cent.

3.1.3.5.2 Frames are attached to the floors and beams by the brackets meeting the requirements of 1.3.4.

Joints of frames to the bottom and deck longitudinals — refer to 2.3.3.2. No overlapping joints are allowed.

3.1.3.5.3 Where the inner skin is provided, scantlings of frames and vertical stiffeners of the inner skin are to meet the requirements of 2.10.

3.1.3.6 In the absence of the inner skin and where bottom and deck are longitudinally framed, web frames scantlings are to be equal to those of a solid floor and deck transverse at the lower end and upper end, respectively. Transverse deep members are to be joined as shown in Fig. 2.3.6.

3.1.3.7 Side and inner skin longitudinals.

3.1.3.7.1 The section modulus of side longitudinals (in the absence of inner skin) and inner skin longitudinals W, in cm^3, is not to be less than that determined by the following formula:

$$W = 6{,}3a(D + h)l^2 \qquad (3.1.3.7.1)$$

where h = refer to 3.1.3.1.2;
l = refer to 2.3.5.1.

3.1.3.7.2 Where side and deck are longitudinally framed, vertical flanged brackets spaced not more than 1 m apart are to be fitted between the upper side longitudinal and the deck longitudinal nearest to the ship's side.

Thickness of brackets s is to be equal to that of the side plating, and the flange width — to $10s$. Brackets are to be welded to longitudinals, as well as to the deck and side plating (refer to Fig. 3.1.3.7.2).

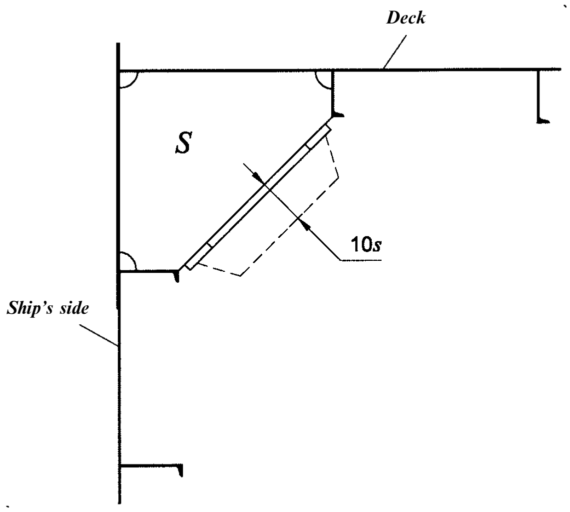


Fig. 3.1.3.7.2

3.1.3.7.3 Where the inner skin is provided, scantlings of the side and inner skin longitudinals are to meet the requirements of 2.10.

3.1.3.8 Beams and deck transverses in cargo tanks.

3.1.3.8.1 The section modulus of beams and deck transverses W, in cm^3, is not to be less than that determined by the following formula:

$$W = ka_1hl^2, \qquad (3.1.3.8.1)$$

where k = factor equal to:
6 — for beams of the transversely framed deck;
5,3 — for deck transverses with longitudinally framed deck and transversely framed side;
4,5 — for deck transverses with longitudinally framed deck and side;
a_1 = beams or deck transverses spacing, in m;
h = refer to 3.1.3.1.2;
l = for beams — refer to 2.5.2.1;
$l = B_1$ — for deck transverses (refer to 3.1.3.1.2).

3.1.3.8.2 Beams are to be attached to frames and vertical stiffeners of the longitudinal bulkhead by brackets meeting the requirements of 1.3.4. Where beams are cut at the bulkhead, brackets are to be fitted on both sides of the bulkhead. Thickness of brackets is to be by 2 mm greater than that of the longitudinal bulkhead plating according to 3.1.3.13.2, and the end beams are to be fitted not more than 25 mm from the bulkhead.

Where deck transverse webs do not penetrate the longitudinal bulkhead, they are to be attched to it by brackets, which length of the free edge over the deck transverse is equal to 1,5 times the beam height, and over the bulkhead — to the beam height. Thickness of brackets is to be by 2 mm greater than that of the beam web. End deck transverses are to be fitted not more than 40 mm from the bulkhead.

3.1.3.9 Deck longitudinals in cargo tanks.

The section modulus of deck longitudinals W, in cm^3, is not to be less than that determined by the following formula:

$$W = 4a(h + L/50)l^2 \qquad (3.1.3.9)$$

where l = deck longitudinals span, including attachments of their ends, in m, but not less than 2 m;
h = refer to 3.1.3.1.2;
a = deck longitudinals spacing, in m.

3.1.3.10 Deck girders in cargo tanks.

3.1.3.10.1 The number of deck girders for transversely framed deck is determined such that a beams span does not exceed 3,0 m. Deck girders are to be fitted as an extension of longitudinal bulkheads of a cargo hold and extended as far as possible towards the ship's ends.

3.1.3.10.2 The section modulus of deck girders W, in cm^3, is not to be less than that determined by the following formula:

$$W = khbl^2 + 35 \qquad (3.1.3.10.2)$$

where k, b, l = refer to 2.5.5.2;
h = refer to 3.1.3.1.2.

3.1.3.10.3 Where deck is longitudinally framed, the absence of deck girders is subject to special consideration by the Register.

3.1.3.11 The transition from a longitudinal bulkhead to a deck girder within a cofferdam is to be effected with a bracket. Brackets are to be dimensioned according to Fig. 3.1.3.4.

3.1.3.12 Pillars in cargo tanks.

The cross-sectional area of a pillar f, in cm^2, and its minimum moment of inertia I, in cm^4, are not to be less than those determined by the following formulae:

$$f = 2{,}2hbl; \qquad (3.1.3.12\text{-}1)$$

$$I = 2{,}4hbll_1^2 \qquad (3.1.3.12\text{-}2)$$

where b, l, l_1 = refer to 2.5.6;
h = refer to 3.1.3.1.2.

3.1.3.13 Plating of cargo tank bulkheads.

3.1.3.13.1 The plating thickness of transverse bulkheads of cargo tanks is determined by Formula (2.7.2.1) at the value of z measured from the lower edge of a bulkhead to the upper edge of an expansion tank plus 0,5 m, but not less than 1 m (for tankers of type **N**) and 1,5 m (for tankers of type **C**) above the deck, but not less than the head corresponding to the setting pressure of a safety relief valve, where relevant, and at k = 2. In any case, the thickness of buklhead plating is not to be less than 5 mm.

3.1.3.13.2 The plating thickness of longitudinal bulkhead and inner skin plating amidships is to be 0,5 mm greater than that of transverse bulkheads required by 3.1.3.13.1. Outside the above area, that thickness is to be equal to that of the plating of transverse bulkheads.

3.1.3.13.3 The plating thickness of cofferdam bulkheads having no contact with cargo tanks is determined by Formula (2.8.2) at the value of h measured to the top of an air pipe, but not less than 1,5 m above the deck. The thickness is not to be less than 5 mm.

3.1.3.14 Framing of cargo tank and cofferdam bulkheads.

3.1.3.14.1 The section modulus of stiffeners of the cargo tank and cofferdam bulkheads W, in cm^3, is not to be less than that determined by the following formula:

$$W = ka(l + 2h)l^2 \qquad (3.1.3.14.1)$$

where k = factor equal to:
3,0 — for bracketless joint of stiffener ends;
2,0 — for attachment of upper and lower ends of stiffeners with brackets;
2,1 — for attachment of upper and lower ends of stiffeners at longitudinal bulkheads with brackets;
l = stiffeners span (including end brackets, if any), in m;
h = refer to 3.1.3.1.2.

3.1.3.14.2 The section modulus of horizontal stiffeners of longitudinal bulkheads is not to be less than that determined by the following formula:

$$W = 4a(D + h + 0{,}01L)l^2, \qquad (3.1.3.14.2)$$

where l = stiffener span measured between its supports, in m;
h = refer to 3.1.3.1.2.

3.1.3.14.3 If longitudinal system of framing is adopted, profile of vertical stiffeners of longitudinal bulkheads is to be at their lower end the same as of solid floors, and at the upper end — as of deck transverses. The profile of the vertical stiffener is to be smoothly changed over its length.

3.1.3.15 Corrugated bulkheads are to meet the requirements of 2.7.5 where h is replaced by its value according to 3.1.3.1.2, and the factor c is taken equal to 15.

3.1.3.16 Holes in webs of framing members.

The webs of floors and side girders are to be provided with drain holes, and the webs of beams and deck girders are to be provided with holes for gas passing.

In scalloped frames the arrangement of such holes is not compulsory.

3.2 PUSHERS AND PUSHED BARGES, LIGHTERS

In addition to the requirements specified in Sections 1 and 2, pushers and pushed barges are to meet the additional requirements given below.

3.2.1 Pushers.

3.2.1.1 Longitudinal bulkheads, frames or trusses firmly joined to the ship's hull and brought to the forepeak bulkhead are to be fitted in the plane of towknees.

Those bulkheads or trusses are to be continued as solid carlings and bottom stringers dimensioned according to 2.5.5 and 2.2.4.5.

3.2.1.2 The deck stringer is to be brought to the transom forepeak bulkhead.

3.2.1.3 Plate thickness of transom forepeak bulkhead plating and of towknees is to be increased on agreement with the Register, and in so doing, it is not to be adopted less than the thickness of deck plating in the fore end.

3.2.1.4 Where frames or trusses are fitted in the towknees plane, the forepeak bulkhead is to be stiffened in the plane of these structures by vertical webs dimensioned at least as carlings they are attached to.

3.2.1.5 Shelves joined to side stringers with brackets are to be fitted on the forepeak bulkhead in the plane of side stringers. The shelf scantlings are to be the same as of the stringer according to 2.3.7.1.

3.2.1.6 Welding of longitudinal deep members within the forepeak is to be effected by continuous double welds.

3.2.2 Pushed barges.

3.2.2.1 In order to take forces from pusher towknees or other pushing couplings, the hull is to be reinforced as follows:

.1 carlings and side stringers are to be fitted in the plane of towknees or other pushing couplings and brought to at least the afterpeak and forepeak bulkheads.

The section modulus of side stringers is to be not less than that of solid floors amidships.

The carlings depth is to be at least $0{,}1l$ (l = transom height);

.2 in the plane of towknees or in the plane where the pusher's towknees may bear against transom bulkheads, the latter are to be stiffened with brackets of a T-section having a depth equal to that of an adjacent carling.

Brackets are to be joined to carlings and side stringers;

.3 in the plane of side stringers and carlings, the afterpeak and forepeak bulkheads are to be reinforced with stiffeners dimensioned as carlings.

3.2.2.2 Regardless of a framing system, the following minimum thicknesses is to be kept (the greatest of the values obtained below is adopted for the bottom plating):

deck stringer $s = 0{,}07L + 4$; (3.2.2.2-1)

bottom plating $s = 0{,}055L + 3$; (3.2.2.2-2)

bottom plating $s = 5{,}5a\sqrt{L + 0{,}6}$; (3.2.2.2-3)

bottom plating $s = 10a$; (3.2.2.2-4)

side plating $s = 1{,}55a\sqrt{L}$. (3.2.2.2-5)

The thickness of side plating at the ship's ends over the length of not less than the ship's breadth is to be equal to that of the plating amidships.

The thickness of deck plating of pushed barges s, in mm, at the ship's ends is not to be less than that determined by the following formula:

$s = (0{,}05L + 3)(a/0{,}5)$. (3.2.2.2-6)

3.2.2.3 At the forward and aft ends of pushed barges a plate is to be arranged athwart ships across the deck from the top edge of a transom bulkhead. The thickness of that plate s, in mm, is to be not less than that determined by the following formula:

$s = 0{,}07L + 4$. (3.2.2.3-1)

The width b, in mm, of that plate is to be not less than that determined by the following formula:

$b = 5L + 300$. (3.2.2.3-2)

3.2.2.4 Transom bulkheads.

3.2.2.4.1 Barges without towknees are to have their sheer strake brought to transom bulkheads and running along their top edge. The transom bulkhead plating below the sheer strake is to be by 2 mm thicker than side plating amidships.

3.2.2.4.2 Barges provided with towknees are to have the thickness of transom bulkhead plating s, in mm, not less than that determined by the following formula:

$s = 0{,}07L + 6$. (3.2.2.4.2)

3.2.2.5 Shelves joined to side stringers are to be fitted on a transom bulkhead in the plane of side stringers. These shelves are to be dimensioned as side stringers according to 2.3.7.1.

3.2.2.6 The section modulus of transom bulkhead stiffeners is to be by 50 per cent greater than that determined by the Formula (2.3.2.1) with a value of l assumed as the transom height.

Frame ends are to be joined to adjacent stiffeners or members with brackets.

3.2.2.7 Towknees are to be securely joined to the hull. The box-shaped towknees are recommended. The thickness of the face plate of the towknee s, in mm, is to be not less than that determined by the following formula:

$s = 0{,}10L + 8$. (3.2.2.7-1)

The thickness of side plating of the towknee s, in mm, is to be not less than that determined by the following formula:

$s = 0{,}08L + 5$. (3.2.2.7-2)

3.2.2.8 Longitudinal deep members in the ship's peaks are to be joined by a continuous double weld.

3.2.2.9 The number of bottom stringers for pushed barges with a double bottom may be reduced, as compared to 2.2.4.1, down to three (two side and one central).

3.2.3 Lighters.

For ship-borne lighters whose length does not exceed 40 m the collision bulkheads referred to in 2.7.1.1 and 2.7.1.2 can be dispensed with if their front faces are able to bear a load at least 2,5 times that set for the collision bulkheads on inland navigation ships with the same draught.

3.3 SHIPS CARRYING DECK CARGO (SHIPS-PLATFORMS)

3.3.1 Scope of application.

The requirements of the present Chapter apply to dry cargo ships carrying deck cargo (ship-platforms) which main dimensions do not demand checking strength according to 1.1.2.2 and 1.1.2.4.

3.3.2 General.

3.3.2.1 A longitudinal bulkhead is to be fitted in the central plane of ships carrying deck cargo. On agreement with the Register, the longitudinal bulkhead may be replaced by a girder frame of equivalent stiffness. Structures with pillars may also be used for ships with loading sequence "B".

3.3.2.2 The bottom framing is to be properly joined to the deck one. In this case, a girder frame is used on ships with loading sequence "A", and pillars, with loading sequence "B". When pillars are used, calculating floors according to the Formula (3.3.3.2) the ship's breadth B is assumed as B_1.

3.3.2.3 Trusses in longitudinal bottom and deck framing system are to be arranged in the planes of all transverse deep members of the hull (refer to Fig 3.3.2.3-1), and in transverse bottom and deck framing system, in the planes of all the main longitudinals of the deck and bottom (refer to Fig. 3.3.2.3-2).

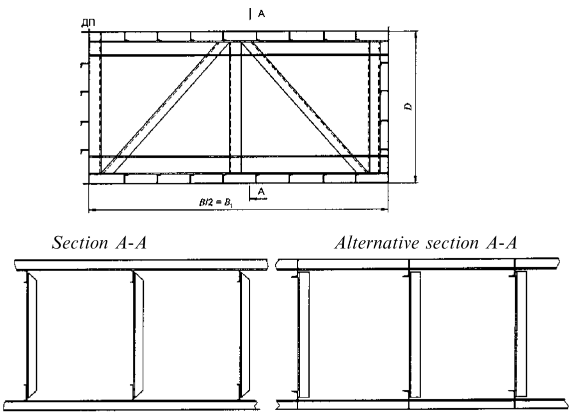


Fig. 3.3.2.3-1

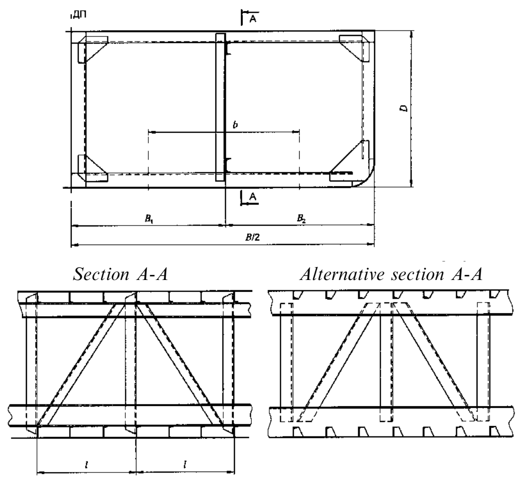


Fig. 3.3.2.3-2

3.3.3 Hull components.

3.3.3.1 The requirements of Sections 1, 2 and of 3.2 apply to the hull components not specified in the present Chapter.

3.3.3.2 Solid floors and bottom stringers.

3.3.3.2.1 The section modulus of solid floors W, in cm^3, is to be not less than that determined by the following formula:

$$W = kk_1a_1(d + 0{,}6)B_1^2 \qquad (3.3.3.2)$$

where k = 4,5 — for longitudinal bottom framing system;
k = 6,0 — for transverse bottom framing system;
for k_1 = refer to 2.2.1.5;
k = 1 if bottom stringers are lacking;
for a_1 = refer to 2.2.1.3;
d = the ship's draught, in m;
B_1 = solid floor span, in m, measured between the floor supports, but at least the ship's depth D. Solid floor supports are considered the ship's sides, longitudinal bulkheads and longitudinal girder frames.

3.3.3.2.2 Where solid floors made of symmetric sections are fitted over top edges of bottom longitudinals, the joints between the above longitudinals and solid floors are to comply with 3.1.3.1.4 and 3.1.3.1.5.

3.3.3.2.3 The section modulus of a bottom stringer W, in cm^3, is to be not less than that determined by the following formula:

$$W = 6b(d + 0{,}6)l^2 \qquad (3.3.3.2.3)$$

where b = the width measured between the middles of non-stiffened bottom areas on both sides of a bottom stringer, in m (refer to Fig. 3.3.2.3-2);
l = bottom stringer span, in m. Bottom stringer supports are considered transverse bulkheads and truss nodes.

The section modulus of a bottom stringer is not to be less than that of a floor.

3.3.3.3 Deck.

3.3.3.3.1 Deck framing.

Structural components of deck framing are to be determined according to the requirements of 2.5. In this case, the effective loading p, in kPa, equal to:

$$p = 10\gamma h \qquad (3.3.3.3.1)$$

where γ = deck cargo density, in t/m^3;
h = mean height of a cargo above the deck, in m,

but not greater than 30 kPa, is to be used in the relevant formulae for determination of the section modulus W of deck framing members.

Where the effective deck loading is over 30 kPa, the calculation of deck framing strength is to be submitted to the Register for approval.

3.3.3.3.2 Deck plating.

The plating thickness s_2, in mm, in way of a cargo deck is to be not less than that determined by the following formula:

$$s_2 = (s + \sqrt{s^2 + 4s_1^2})/2 \qquad (3.3.3.3.2)$$

where s = deck plating thickness determined according to 2.4.1. In the presence of carlings according to 2.4.1 the thickness s determined by the Formula (2.4.1.1-1) may be reduced by 6 per cent with three carlings and by 3 per cent for each following carling;
s_1 = $1{,}7a\sqrt{p}$, in mm;
a = spacing between deck framing components, in m;
p = loading according to 3.3.3.3.1, in kPa.

Where grabs or other mechanized means are used in cargo operations, this thickness for decks without deck planking is to be increased at least by 3 mm.

3.3.3.4 Structures with girder frames.

3.3.3.4.1 Structures consisting of a deck and a bottom member, pillars and diagonal braces are to be fitted in a transverse direction for longitudinal framing system of the hull (refer to Fig. 3.3.2.3-1) and in a longitudinal direction for transverse framing system of the hull (refer to Fig. 3.3.2.3-2).

3.3.3.4.2 Scantlings of deck and bottom members of the structures with girder frames (floors and beams, or bottom stringers and carlings) are determined according to 2.2.1, 2.2.4, 2.5.4 and 2.5.5. Pillar scantlings are determined according to 2.5.6.

Brace scantlings are determined according to the requirements of 2.5.6 depending on a design load N_d and a reduced length l_r.

The design load N_d, in kN, is calculated by the following formula:

$$N_d = N/2k\cos\alpha \qquad (3.3.3.4.2\text{-}1)$$

where N = design load on a pillar determined by the Formula (2.5.6.3-2);
α = angle between the longitudinal axes of the pillar and brace;
k = factor equal to:
1 — for structures designed according to Figs. 3.3.3.4.2(*a*) and (*b*);
2 — for structures designed according to Fig. 3.3.3.4.2(*c*).

The reduced length of a brace l_r, in m, is determined by the following formula:

$$l_r = k_1 l_{br} \qquad (3.3.3.4.2\text{-}2)$$

where l_{br} = full brace length, in m;
k_1 = factor equal to:
1 — for the structures shown in Figs. 3.3.3.4.2(*a*) and (*b*);
0,6 — for the structure shown in Fig 3.3.3.4.2(*c*).

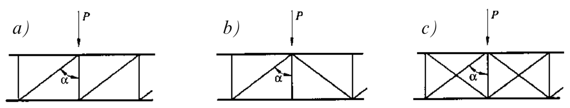


Fig. 3.3.3.4.2

3.4 SHIPS WITH LARGE DECK OPENINGS

3.4.1 General.

3.4.1.1 Ships with large deck openings are ships with hatch openings width is $\geqslant 0{,}7$ of the ship's breadth.

3.4.1.2 The rated width of a deck stringer for dry cargo ships c_o, in mm, is determined by the following formula:

$$c_0 = 0{,}66dl^2\sqrt{kd/Dfy} \qquad (3.4.1.2)$$

where l = length of the ship's longest cargo hold between transverse bulkheads, in m;
k = factor equal to:
1 — for ships with one continuous hold;
2,2 — for ships with two holds approximately of the same length;
2,4 — for ships with three holds, the middle one is essentially shorter than the adjacent;
f = adopted cross section of a sheer strake, in cm^2, or the cross section of the hatch coaming plate above the deck up to the height equal to the 50-fold thickness of the coaming, and with the ship's double side, down to the level of the same height below the deck including the cross section of all the longitudinal stiffeners of the coaming above the deck. The greater of the above values is used in the calculation;
y = permissible displacement of coaming face plates in a horizontal plane which is generally to be not greater than:
1,5 cm — for ships with movable hatch covers;
2 cm — for ships with hatch boards or other lift-off hatch covers;
3 cm — for ships up to 40 m long without hatches (open ships);
4 cm — for ships over 40 m long without hatches (open ships).

Regardless of the closure type or the ship's length, the coaming deflection is to be not more than 1/800 of the length of the longest cargo hatch.

3.4.1.3 The thickness of a deck stringer s_c, in mm, is to be not less than that determined by the following formula:

$$s_c = (10/c_0)(40Bs - 1{,}8F_k - 0{,}90F_{PB}) \qquad (3.4.1.3)$$

where c_0 = rated width of a deck stringer according to 3.4.1.2, in cm;
s = thickness of deck plating according to 2.4.1.1, in cm;
F_k = cross-sectional area of a coaming above the deck including the area of its longitudinal stiffeners, in cm^2;
F_{PB} = sum of cross-sectional areas of coamings under the deck, of areas of longitudinal underdeck members and of areas of the sheer strake cross section exceeding those required according to 2.1.4.2, in cm^2.

In any case, the thickness of a deck stringer is to be not less than that of the deck stringer of a strength deck required in accordance with 2.4.2.

3.4.1.4 Where the adopted width c_1 of a deck stringer on cargo ships with large deck openings with a single or double side is less than the rated width c_0 determined according to 3.4.1.2, the hull framing is to be reinforced according to 3.4.2, 3.4.3 and 3.4.4.

3.4.1.5 Where the length of one hold of cargo ships with large deck openings exceeds $0{,}5L$, the arrangement of a double side is recommended in accordance with 2.9.11.

3.4.2 Side framing.

3.4.2.1 The section modulus of web frames determined according to 2.3.6.4 is to be increased by multiplying by the ratio c_0/c_1.

3.4.2.2 Section moduli of main frames and side longitudinals determined according to 2.3.2 and 2.3.5 are to be increased in proportion to the value $\sqrt{c_0/c_1}$.

3.4.3 Bottom framing.

3.4.3.1 The section modulus of deep floors, to which web frames reinforced according to 3.4.2.1 are joined, determined according to 2.2.1.3 and 2.2.1.13 is to be increased by multiplying by the ratio c_0/c_1.

3.4.3.2 The section modulus of solid floors, to which main frames are joined, determined according to 2.2.1.3 is to be increased in proportion to the value $\sqrt{c_0/c_1}$.

3.4.3.3 The bottom stringers arranged at the ship's sides are to be also solid on ships to which the requirement 2.2.4 does not apply.

3.4.4 Deck stringer on ships with large deck openings.

3.4.4.1 Where the rated width of a deck stringer c_o due to structural and operational features of a ship cannot be ensured, the thickness of the deck stringer determined according to 3.4.1.3 is to be increased by multiplying by the ratio c_0/c_1.

3.4.4.2 If the width of the deck stringer is greater, the strength of the hull structure is not to be lowered.

3.5 SHIPS FOR THE CARRIAGE OF CONTAINERS IN HOLDS

3.5.1 Scope of application.

3.5.1.1 The requirements of the present Chapter apply to dry cargo ships intended for the specialized carriage of containers in holds, as well as to ships for general cargo carriage, which may be used for random carriage or containers.

3.5.1.2 The requirements cover the longitudinal stowage of containers in 2, 3 and 4 rows across the breadth and not more than in 5 tiers through the height.

3.5.1.3 The design of ships-platforms intended for the carriage of containers is subject to special consideration by the Register.

3.5.1.4 General cargo ships having the double bottom plating 9 mm and more thick may carry one tier of containers. Where the corner fitting of a container does not get to the main carrying member (solid floor or stringer), the bottom structure is to be reinforced: e.g. wooden bars providing the uniform response to loading from the container and the distribution of this loading among deep members of the bottom are to be fitted under longitudinal sides of the container.

3.5.2 General.

3.5.2.1 The additional requirements refer to bottom framing only. The ship's bottom components are also to meet the requirements of Section 2 and of 3.2.2.

3.5.2.2 Bottom framing system may be transverse or longitudinal, but in any way solid stringers are to be arranged under container fittings (Figs. 3.5.2.2-1, 3.5.2.2-2). Transfer of fittings loading to stringers is to be effected through the plate $12 \times 430 \times 460$ m or the container socket welded in the double bottom plating (Fig. 3.5.2.2-3).

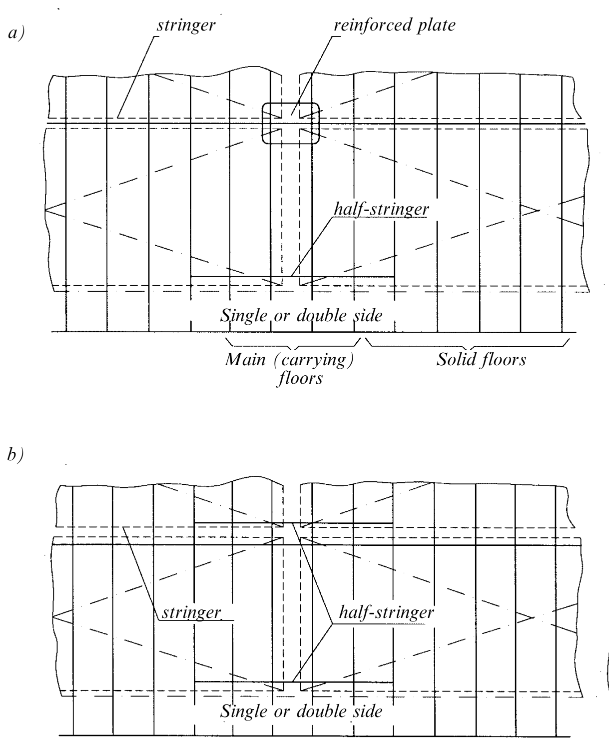


Fig. 3.5.2.2-1 Transverse framing system

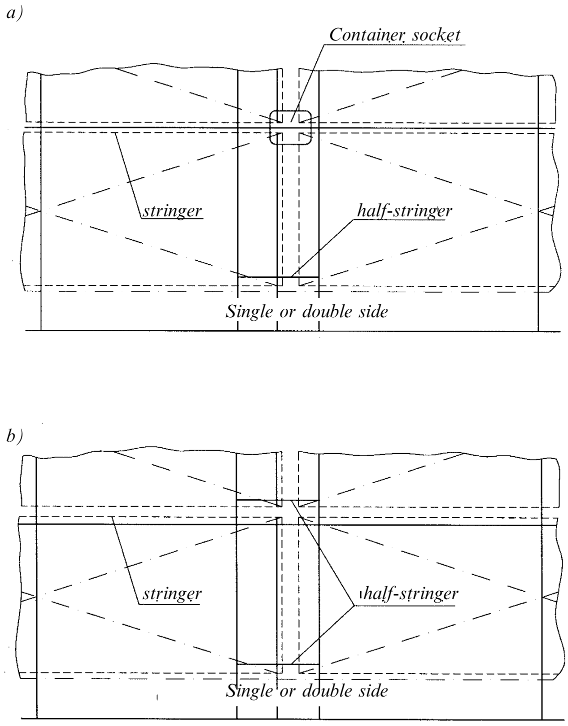


Fig. 3.5.2.2-2 Longitudinal framing system

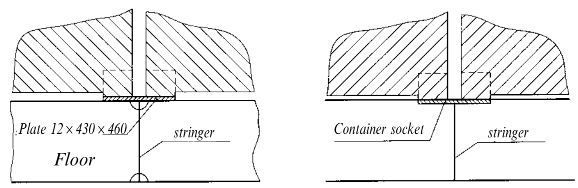


Fig. 3.5.2.2-3

3.5.2.3 Where a stringer supports a row of fittings, a half-stringer at least two spacings long is to be fitted under the adjacent row (Fig. 3.5.2.3). The reinforced plate for such a structure is not needed if the thickness of double bottom plating is at least 9 mm. Other structures for fittings stiffening are allowed on agreement with the Register.

3.5.2.4 Locations of containers stowage are to be marked where reinforced plates or container sockets are absent.

3.5.2.5 Reinforced plates according to 3.5.2.2 are to be fitted in places where stringers and main floors cross, or brought to two adjacent floors (Fig. 3.5.2.2-1(*a*)).

3.5.2.6 No openings in webs of floors, stringers and half-stringers in way of the reinforced plate of the double bottom plating are allowed.

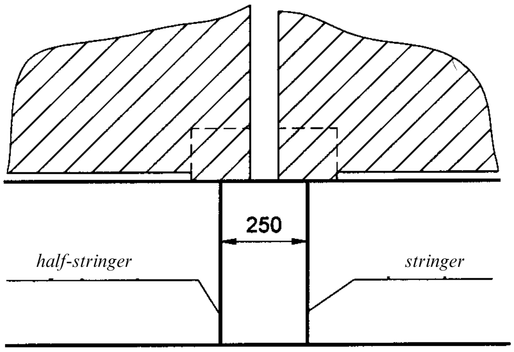


Fig. 3.5.2.3

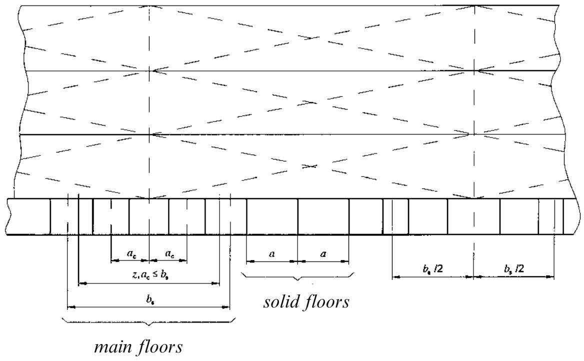


Fig. 3.5.3.1

3.5.2.7 The procedure for containers loading (unloading) is to be regulated (one layer at a time or in an arbitrary way).

3.5.2.8 The Register may also demand additional calculations of strength and stability of bottom structure components.

3.5.2.9 Structural components of the bottom may be dimensioned according to the procedure approved by the Register.

3.5.3 Bottom structure.

3.5.3.1 The section modulus of floors W_1, in cm^3, bearing containers loading is to be not less than determined by the following formula:

$$W_1 = 7{,}7 M_c(1/z) - 5{,}7 M_w a_c \qquad (3.5.3.1\text{-}1)$$

where $M_c = 0{,}25 P_c n[m(B - 7{,}32) + 9{,}76]$, in kNm, (3.5.3.1-2)

where P_c = design weight of a container, in kN;
n = number of container rows through the hold height;
m = number of container rows across the hold breadth;
z = number of solid floors bearing the loading from adjacent containers is assumed equal to no more than the actual number of floors located in the area b_s long according to Table 3.5.3.1 and Fig. 3.5.3.1;
a_c = spacing between the floors bearing container loading, in m;
b_s = design length of the bottom section (along the ship) under containers which is to be assumed no more than specified in Table 3.5.3.1;

Table 3.5.3.1

Number of containers across the ship's breadth		m = 2	m = 3	m = 4
b_s, in m	for 20′ containers	⩽3,95	⩽5,15	⩽5,70
	for 40′ containers	⩽5,30	⩽8,30	⩽9,90

$$M_w = 1{,}22 B^2 (d_c^{min} + 0{,}6) \qquad (3.5.3.1\text{-}3)$$

where d_c^{min} = minimum draught of the ship at the start of loading which is to be assumed not more than 0,6 d_c and not less than 0,6 m;
d_c = draught of a ship loaded by containers, in m.

3.5.3.2 When containers are loaded/unloaded in an arbitrary way (refer to 3.5.2.7), the section modulus W_2, in cm^3, of each floor in a hold is also to be not less than the W_1 value (determined according to 3.5.3.1) and is determined by the following formula:

$$W_2 = 6{,}95 B_1^2 a(d_c + 0{,}6) \qquad (3.5.3.2)$$

where a = actual floors spacing, in m;
for B_1 = refer to 2.2.1.3.

3.5.3.3 The section modulus of floors outside the length (z, a_c) range (not carrying containers) is determined according to 2.2.1.3 with due regard for the reinforcement according to 3.4.3.

3.5.3.4 The area (net) of the solid floor web f_1, in cm^2, between a side (or longitudinal bulkhead) and the nearest stringer is to be not less than that determined by the following formula:

$$f_1 = 0{,}06 P_c nm/z - 0{,}74 B a_c (d_c^{min} - 0{,}6). \qquad (3.5.3.4\text{-}1)$$

In the following sections between stringers, $f_{1(i)}$, in cm^2, is reduced according to the following scheme:

$$f_{1(i)} = f_{1(i-1)} - \Delta f_1, \qquad (3.5.3.4\text{-}2)$$

crossing every continuous stringer towards the central plane, but not more than down to 1/2 f_1, where Δf_1, in cm^2, is determined by the following formula:

$$\Delta f_1 = 0{,}03 P_c n 1/z. \qquad (3.5.3.4\text{-}3)$$

3.5.3.5 When containers are loaded in an arbitrary way, the area (net) of the floor web between a side (or longitudinal bulkhead) and the nearest stringer f_1, in cm^2, is to be not less than that determined by the following formula:

$$f_1 = 0{,}446 Ba(d_c + 0{,}6). \qquad (3.5.3.5\text{-}1)$$

In the following sections between stringers, f_1 is reduced according to the scheme $f^{(y)}$, in cm^2:

$$f^{(y)} = 2 f_1 Y/B \qquad (3.5.3.5\text{-}2)$$

where Y = distance from the central plane to the cross section in question, in m, but not more than to the f_1 section.

3.5.3.6 The area (net) of every stringer web and a vertical keel f_2, in cm^2, is to be not less than that determined by the following formula:

$$f_s = 0{,}06 P_c n. \qquad (3.5.3.6\text{-}1)$$

This area may be reduced by Δf_2, in cm^2, outward from the container corner:

$$\Delta f_2 = 2 f_2 a / b_s, \qquad (3.5.3.6\text{-}2)$$

crossing every solid floor, but not more than down to $1/2 f_2$.

3.6 STRENGTHENING OF SHIPS FOR NAVIGATION IN BROKEN ICE

3.6.1 General.

Ships with ice strengthening, in accordance with the requirements of the present Chapter, get a mark **Ice** in the class notation. The ships are strengthened for navigation in broken ice on the Shipowner's demand only.

3.6.2 Ice strengthening of framing and plating.

3.6.2.1 Stem.

3.6.2.1.1 Scantlings of a bar stem specified in 2.10.2.1 are to be increased by 25 per cent.

The stems of a solid transverse cross section other than the rectangular one are to have the same section modulus about the vertical axis as the stems with the cross section required according to 2.10.2.1 and increased by 25 per cent.

3.6.2.1.2 The thickness of a plate stem or the stem of angle bars as determined according to the Formula (2.10.3.1) is to be increased by 30 per cent.

3.6.2.2 Bottom framing.

3.6.2.2.1 Bottom framing in the ship's fore end is to be designed on the basis of transverse framing system.

3.6.2.2.2 Solid floors thickness in the ship's fore end as required according to 2.2.1.10 is to be increased by 15 per cent.

3.6.2.3 Side framing.

3.6.2.3.1 Intermediate frames are to be fitted in the ship's fore end as far as the parallel middlebody of the hull; intermediate frames on pushed barges are to be fitted up to the fifth frame from the beginning of the parallel middlebody of the ship's hull.

3.6.2.3.2 Section moduli of frames and intermediate frames within the section specified in 3.6.2.3.1 are to be increased by 20 per cent as compared with those required according to 2.3.2 and 2.3.4.

3.6.2.3.3 The number of side stringers fitted is to be such that their spacing, as well as a distance from them to the top edge of floors and to the deck do not exceed 0,8 m.

Section modulus of those stringers and their design are to meet the requirements of 2.3.7.

3.6.2.4 Shell plating.

The side plating strake in the ship's fore part ahead of the beginning of the parallel hull middlebody within a length of at least the ship's breadth B is to have the thickness increased by 25 per cent as compared with that required according to 2.4.2.3. The above strake within the rest length of the ship is to have the thickness increased by 15 per cent as compared with that required according to 2.4.2.3.

The top edge of the ice strake is to run by 500 mm above the load waterline, and the lower edge, by 500 mm below the light waterline.

Where the section of bottom shell plating spaced from a ballast waterline for less than 500 mm is in the above-mentioned area, the thickness of the bottom shell plating in that area is to be at least the ice strake thickness.

3.6.2.5 Side framing and shell plating of pontoons and pushers are to be stiffened within the section of $0{,}2L$ from the ship's stern in accordance with 3.6.2.3 and 3.6.2.4.

3.7 DRY CARGO SHIPS FOR THE CARRIAGE OF DANGEROUS GOODS

3.7.1 The requirements of the present Chapter apply to dry cargo ships for the carriage of dangerous goods.

3.7.2 Dry cargo ships for the carriage of dangerous goods are to have the double bottom and double side in way of cargo tanks.

3.7.3 The requirements of the present Chapter do not revoke those in Sections 1, 2 and in 3.2 to 3.6, if the latter are applicable.

3.7.4 The cargo hold is to be separated from fuel storage tanks by a cofferdam extended for not less than 500 mm.

3.7.5 The depth of double bottom is not to be less than 500 mm.

It may be reduced to 400 mm under a bilge well, provided the capacity of the latter does not exceed 0,03 m^3.

Where fuel storage tanks are arranged in the double bottom, its depth is not to be less than 600 mm.

3.7.6 The breadth of double side is not to be less than 800 mm.

On agreement with the Register, it may be reduced to 600 mm, provided the side framing is reinforced according to 3.7.6.1 or 3.7.6.2, and also to 3.7.6.3 and 3.7.6.4.

3.7.6.1 Where double side is longitudinally framed, the frames spacing is not to exceed 600 mm. Longitudinals are to be supported by diaphragms according to 3.7.7, which are spaced within 1,8 m apart.

3.7.6.2 Where double side is transversely framed, two alternatives for reinforcements are allowed:

.1 fitting of not less than two longitudinal side stringers. In this case, their spacing and the distance between the upper side stringer and deck stringer are not to exceed 800 mm.

The thickness of the side stringer web is not to be less than that of a web frame, the cross section area of the face plate is not to be less than 15 cm^2.

Side stringers are to be supported by diaphragms according to 3.7.7 spaced within 3,6 m apart.

Side shell frames and vertical stiffeners of the inner skin bulkhead are to be joined at the lower part of the double-hull space with a bracket of not less than 900 mm in height and with a thickness equal to that of the bottom plating;

.2 fitting of diaphragms according to 3.7.7 in each spacing.

3.7.6.3 The deck stringer is to be supported by transverse bulkheads spaced within 32 m apart.

On agreement with the Register, other design ensuring transverse strength of the ship's structure may be used.

3.7.7 Diaphragm is a vertical plate structure extended athwartships from the side shell to the inner skin bulkhead, and from the deck stringer to the bottom plating or floor throughout the height.

The diaphragm thickness s, in mm, is not to be less than that determined by the following formula:

$$s = 0,78\sqrt{L}. \qquad (3.7.7)$$

The total width of openings in one section of the diaphragm is not to exceed 0,6 of the double side breadth.

APPENDIX

TIGHTNESS TEST OF SHIP'S HULL

During construction of every ship, its hull is to be subjected to tightness test according to the provisions of this Table and methods approved by the Register.

Table

Item number	Hull structure to be tested	Test methods and standards	Remarks
1	Forepeak and afterpeak:		
	.1 used as water compartments	Filling with water with head up to the top of overflow[1]	The afterpeak is to be tested with the sterntube and rudder tube fitted
	.2 not intended for filling with water	Filling with water with head up to the highest point of the deck located above the load waterline level and by hose test above that level[1]	If hatch coamings of the forepeak or afterpeak, not intended for filling with water, are less than 0,3 m in height, these compartments are to be filled with water up to the level of the upper edge of the hatch coaming
2	Double bottom tanks (including the duct keel):		
	.1 intended for liquids	Filling with water with head up to the height of 2,50 m above double bottom plating or up to the top of overflow (whichever is greater)[1]	
	.2 not intended for liquids	Filling with water with head up to the height of 0,50 m above the load waterline level[1]	
3	Double side tanks:		
	.1 intended for liquids	Filling with water with head up to the top of overflow, but not below the bulkhead deck[1]	
	.2 not intended for liquids	For ships with double bottom: hose test above the double bottom level[2] For ships without double bottom: filling with water with head up to the top of floors, but not less than 0,35 m from the shell plating at a keel and hose test above that level[2]	
4	Cargo holds of dry cargo ships, engine and boiler rooms, electric propulsion motor rooms:		
	.1 for ships with double bottom	Hose test over the entire surface above the double bottom level[2]	

Table — continued

Item number	Hull structure to be tested	Test methods and standards	Remarks
	.2 for ships without double bottom	Filling with water with head up to the top of floors, but not less than 0,35 m from the bottom shell plating at a keel and hose test above that level[2]	
5	Tanks in 'tween deck space	Hose test[2]	
6	Tanks located outside the double bottom including fuel storage, circulation and daily service tanks, tanks (on dry cargo ships and catcher boats) for storage of vegetable oil, whale oil and other liquid cargoes	Filling with water with head up to the top of overflow, but not below the bulkhead deck and not less than 2,5 m from the tank top[1]	For tanks with overflow pipes led into a manifold, water head during the test is taken to the top of the manifold, but not less than 2,5 m from the tank top
7	Cargo tanks of tanker: .1 cargo tanks of tanker of type **N**	Filling with water with head up to 0,5 m from the top of expansion tank, but not less than 1 m from the highest point of the deck forming the tank top1, but not less than the head corresponding to the setting pressure of a safety relief valve, where relevant	If compartment (hold) structures do not withstand the water head specified, such compartments are tested in two stages: I — on berth: filling with water up to the level exceeding the ship's draught after launching by 0,5 m and hose test above that level; II — afloat: filling with water with head up to 0,5 m from the top of expansion tank, but not less than 1 m from the highest point of the deck forming the tank top, but not less than the head corresponding to the setting pressure of a safety relief valve, where relevant
	.2 cargo tanks of tanker of type **C**	Filling with water with head up to 1,5 m from the highest point of the deck forming the tank top1, but not less than the head corresponding to the setting pressure of a safety relief valve, where relevant	If compartment (hold) structures do not withstand the water head specified, such compartments are tested in two stages: I – on berth: filling with water up to the level exceeding the ship's draught after launching by 0,5 m and hose test above that level; II – afloat: filling with water with head up to 1,5 m from the highest point of the deck forming the tank top, but not less than the head corresponding to the setting pressure of a safety relief valve, where relevant
8	Cofferdams	Filling with water with head up to the top of overflow1, but not less than 1,5 m from the highest point of the deck	
9	Sea chests, ice boxes	Filling with water with head up to the level of 1,25 times the ship's depth, but not less than the pressure in the blowing system	At tests of ice boxes (when heated by steam), the test head is not, in any cases, to be less than the design pressure of the heating system. Where the blowing system is absent, sea boxes are tested at the water head by 0,35 m above the box cover
10	Shaft tunnel, enclosures and escape trunks, as well as tight trunks (including machinery casings, boiler uptakes and funnel casings), vent ducts located inside the hull, superstructures and deckhouses	Hose test[2]	Where the shaft tunnel or trunks pass through the compartments tested by filling with water or by leak test, the appropriate areas of the tunnel and trunks are checked during the test of compartments. Vent ducts are tested similarly, unless provided otherwise in technical documentation
11	Chain lockers: **.1** located abaft the collision bulkhead	Hose test[2]	

Table — continued

Item number	Hull structure to be tested	Test methods and standards	Remarks
	.2 located forward of the collision bulkhead	Hose test[2]	Chain locker structures (or parts thereof) located forward of the collision bulkhead, which were under the pressure during filling forepeak with water, need not be subjected to hose test
12	Tanks within the stern counter	Filling with water with head up to the level of waterline of the ship in the load condition; hose test above that level[2]	
13	Superstructures and deckhouses (including exposed parts of machinery and funnel casings)	Hose test[2]	
14	Exposed parts of decks (including superstructure and deckhouse decks)	Hose test[2]	Parts of exposed decks in the cargo area of tankers are tested simultaneously with the relevant compartments (refer to item 7 of the Table)
15	Hatchway and ventilator coamings on exposed parts of the upper deck, as well as decks of superstuctures and deckhouses	Hose test[2]	Hatch coamings up to 100 mm in height may be tested by wetting with kerosene
16	Closing appliances of openings in tight structures of the ship's hull: doors in subdivision bulkheads; doors in outer sides of superstructures and deckhouses; shell doors; hatch covers of skylights and companionways; side scuttles in the upper decks and the sides of the main hull, as well as in decks and outer bulkheads of superstructures and deckhouses; covers of manholes in tight decks, platforms and bulkheads; outer side parts of rubbish-shoots; steel covers of cargo hatchways	Hose test (dispersed water jet)[2]	Closing appliances of openings in tight structures of the ship's hull located inside the hull, superstructures and deckhouses may be tested by means of a compressed air jet. Closing appliances of openings (covers of manholes and hatches, slide valves, etc.), as well as air, sounding and other pipes within the double bottom and other compartments, which are tested by filling with water, are to be tested simultaneously with these compartments. If separately tested, they are to be subjected to filling with water with the head corresponding to the test head of that compartment. Doors of subdivision bulkheads are to be pressure tested to a water head up to the bulkhead deck, but not less than 5 m H_2O either before or after the door is fitted in place
17	Anchor hawse pipes and chain pipes	Hose test[2]	
18	Hollow (streamlined) rudders, hollow nozzles and hollow elements of foil structure	Filling with water with head up to the level of 1 m above the upper edge of the rudder (nozzle)	
19	Independent water, fuel and lubricating oil tanks	Filling with water with head up to the top of overflow and air pipe. For fuel and lubricating oil tanks, the head shall not be less than 0,85 m from the highest point of the tank[1]	Independent tanks are to be tested twice: before and after their installation in the ship with all pipings connected
20	Sewage tanks	Filling with water with head equal to 1,5 times the water head from the tank bottom to the lower indicator[1]	
21	Thruster compartments, buoyancy tanks, log and echo sounder trunks	Filling with water with head of 0,50 m above the load waterline level[1]	

[1] On agreement with the Register, the tests of compartments by filling them with water may be replaced by leak test with an excessive pressure of 30 kPa.

[2] For welded joints, except overlap connections, hose test may be replaced by wetting with kerosene.

PART III. EQUIPMENT, ARRANGEMENTS AND OUTFIT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to equipment, arrangements and outfit of inland navigation ships in **Zones 1** to **4**, except hydrofoils, air cushion vehicles and hydrogliders.

Characteristics of zones are given in 2.2.5.1, Part I "Classification".

1.2 DEFINITIONS AND EXPLANATIONS

Definitions and explanations relating to general terminology of the Rules are given in Part I "Classification".

For the purpose of the present Part the following definitions have been adopted.

1.2.1 Principal dimensions of the ship.

Moulded depth D, in m, is the vertical distance measured amidships from the top of the plate keel or from the point where the inner surface of the shell plating abuts upon the bar keel, to the point of intersection of the bottom edge of the deck stringer and the inner edge of the sheer strake, or to the point of intersection of their moulded lines on ships having rounded gunwales.

Length of ship L, in m, is the distance measured on the load waterline between the points of intersection of its forward and aft parts with the centreline plane.

Where the fore or aft ends are of unusual form, the length L is subject to special consideration by the Register.

Draught d, in m, is the vertical distance between the lowest point of the hull without taking into account the keel or other fixed attachments and the maximum draught line.

Moulded breadth B, in m, is the maximum breadth measured amidships between outside edges of frames.

1.2.2 Superstructures, deckhouses and separate areas.

Enclosed superstructure is a watertight continuous structure having closed bulkheads of sufficient strength, permanently so assembled with the deck as to be watertight.

Evacuation areas are a part of muster areas of the ship from which evacuation of persons can be carried out.

Passageway is an area intended for the normal movement of persons and goods.

Muster areas are areas of the ship which are specially protected and in which passengers muster in the event of danger.

Superstructure is a decked structure on the freeboard deck, extending from side to side of the ship or with the side plating not being inboard of the shell plating more than 0,04 of the breadth B.

Control centre is a wheelhouse, an area which contains an emergency electrical power plant or parts thereof or an area with a centre permanently occupied by on-board personnel or crew members for monitoring of remote controls of shipboard equipment.

Deckhouse is a decked structure on the freeboard or superstructure deck which is set in from the sides of the ship for more than 0,04 of the breadth B.

Deckhouses may be arranged in a single or several tiers.

1.2.3 Tightness.

Splashproof is the term pertaining to closing appliances of openings in the above-water part of the hull, which means that in any weather conditions encountered in the navigation area assigned only small quantities of water will penetrate through the openings inside the ship. The test is carried out by watering the entire surface of the closing appliance by a dispersed water jet under a head of at least 100 kPa ejected from a distance not more than 3 m during 10 min. No penetration of water through these closing appliances is allowed during the test.

Watertight is the term pertaining to closing appliances of openings in the above-water part of the hull, which means that when exposed to a pressure of liquid corresponding to water column of 10 m in height during 1 min, or to a water jet under pressure not less than 100 kPa (1 bar) during 10 min ejected over the whole surface of the closing appliance from a distance not more than 3 m, the water will not penetrate through the openings inside the ship.

Gastight is a structural component or device so fitted as to prevent the ingress of gas and vapours.

Weathertight is the term pertaining to closing appliances of openings in the above-water part of the hull, which means that in any weather conditions encountered in the navigation area assigned water will not penetrate through the openings inside the ship.

1.2.4 Decks.

F r e e b o a r d d e c k is the strength watertight deck to which the watertight bulkheads extend. Such deck may be stepped.

On ships having a discontinuous deck the lowest line of this deck and the continuation of that line parallel to upper part of the deck is taken as a freeboard deck.

1.2.5 Rudder and steering gear.

A u x i l i a r y s t e e r i n g g e a r is the equipment other than any part of the main steering gear necessary for steering the ship in case of failure of the main steering gear, but not including the tiller, quadrant or components serving the same purpose.

H a n d - o p e r a t e d h y d r a u l i c s t e e r i n g g e a r is the equipment where the steering engine actuator is brought into operation only by a handwheel (handwheel pump).

M a i n s t e e r i n g g e a r is the machinery, rudder or nozzle rudder actuators, steering gear power units, if any, auxiliary equipment and means of applying torque to the rudder stock (e.g. tiller or quadrant) necessary for effecting movement of the rudder or nozzle rudder for the purpose of steering the ship under normal service conditions.

P o w e r s o u r c e is the power supply to the steering control and the steering apparatus produced by an on-board network, batteries or an internal combustion engine.

S t e e r i n g a p p a r a t u s is the part of steering gear which produces the movement of the rudder.

S t e e r i n g g e a r is all the equipment necessary for steering the ship, such as to ensure the manoeuvrability.

R u d d e r is the rudder or rudders, with shaft, including the rudder quadrant and the components connecting with the steering apparatus.

M a n u a l d r i v e is a system whereby manual operation of the hand wheel, moves the rudder by means of a mechanical or hydraulic transmission, without any additional power source.

S t e e r i n g g e a r p o w e r u n i t i s :

in case of electric steering gear an electric motor and its associated electrical equipment;

in case of electrohydraulic steering gear an electric motor and its associated equipment and connected pump;

in case of other hydraulic steering gear a driving engine and connected pump.

S t e e r i n g g e a r c o n t r o l s y s t e m is the equipment by which orders are transmitted from the navigating bridge to the steering gear power units. Steering gear control systems comprise transmitters, receivers, hydraulic control pumps and their associated motors, electrical and hydraulic device controls, piping and cables.

S t e e r i n g a p p a r a t u s c o n t r o l u n i t is the control for the steering apparatus, its drive unit and its power source.

1.2.6 Life saving appliances.

I n d i v i d u a l l i f e - s a v i n g a p p l i a n c e s are means intended for supporting a person overboard on the water surface. They include lifejackets and lifebuoys.

C o l l e c t i v e l i f e - s a v i n g a p p l i a n c e s are lifeboats, liferafts, ship's boats and life-saving buoyancy aids intended for rescue of passengers and the ship's crew.

L i f e - s a v i n g b u o y a n c y a i d s are means intended for supporting several persons overboard on the water surface.

L i f e r a f t is a raft intended for rescue of people in distress keeping them out of the water.

L i f e b o a t is a boat intended for rescue of people in distress.

S h i p ' s b o a t is a boat used for multipurpose application including transportation of people or cargoes as well as in rescue purposes.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The following items included into the ship's equipment, arrangements and outfit are subject to the Register technical supervision during their manufacture.

1.3.1.1 Rudder and steering gear:

.1 rudder stocks;

.2 rudder blade and nozzle rudders;

.3 rudder axles;

.4 pintles of rudders and nozzle rudders;

.5 fastenings of rudder stocks, rudder stock with rudder or nozzle rudder (bolts, muff couplings, keys).

1.3.1.2 Anchor arrangement:

.1 anchors;

.2 chain cables of more than 6 mm in diameter and ropes.

1.3.1.3 Mooring arrangement:

.1 mooring ropes.

1.3.1.4 Towing and pushing arrangement:

.1 tow lines;

.2 tow hooks with a pull of 10 kN and more;

.3 coupling arrangements of push-tugs, barges and push-trains.

1.3.1.5 Wheelhouse vertical movement arrangement:

.1 hoisting mechanism;

.2 emergency lowering mechanism.

1.3.1.6 Life-saving appliances and launching devices:

.1 lifebuoys and lifejackets;

.2 liferafts;

.3 lifeboats;

.4 life-saving buoyancy aids;

.5 davits and boat winches.

1.3.1.7 Signal means:

.1 navigation and flashing lights;

.2 signal shapes;

.3 sound signals.

1.3.2 The Register technical supervision of the manufacture of items included into the ship's equipment, arrangements and outfit is confined to review of the relevant technical documentation.

1.3.2.1 Rudder and steering gear:

.1 bushes of pintles;

.2 rudder stock bearings.

1.3.2.2 Anchor arrangement:

.**1** anchor hawse pipes;

.2 device for securing anchors for sea.

1.3.2.3 Mooring arrangement:

.1 mooring bollards, belaying cleats, fairleaders, chocks, rollers and stoppers.

1.3.2.4 Towing and pushing arrangement:

.1 towing bollards, bitts, fairleaders, chocks and stoppers;

.2 fastenings for securing tow hooks and towing rails to the ship's hull;

.3 towing rails.

1.3.2.5 Closing appliances of openings in hull, superstructures and deckhouses:

.1 side and deck scuttles;

.2 skylights, deck closures and external doors;

.3 doors in watertight bulkheads.

1.3.2.6 Miscellaneous arrangements and equipment:

.1 inner and outer ladders;

.2 guard rails.

1.3.2.7 Emergency outfit.

1.3.3 For the items specified in 1.3.1 and 1.3.2 the following documents are to be submitted to the Register:

.1 assembly drawing, and for the electrical devices – schematic diagrams, as well;

.2 calculations;

.3 details drawings if parts or assemblies are not manufactured in accordance with standards and specifications approved by the Register;

.4 technical description (specifications) and other necessary documentation on life-saving appliances and arrangements;

.5 specifications or assignment;

.6 test programme;

.7 list of spare parts for signal means.

1.3.4 The components of arrangements, equipment and outfit listed in Table 1.3.4 as well as the materials used for the manufacture of life-saving appliances are subject to the Register control in terms of compliance with the requirements of Part XIII "Materials" and Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships, as well as of Part VIII "Machinery" of the Rules.

1.3.5 Recognition of the signal means which have been manufactured not under the Register technical supervision is granted upon review of the technical documentation (specifications, schemes, test reports, etc.) and upon tests carried out in accordance with the requirements of Section 12. In some cases, the Register may confine itself to review of the test reports confirming compliance with the requirements of the said Section rather than to carry out tests.

Table 1.3.4

Nos	Item	Steel blanks	Amount of testing
1	Rudder stocks including flanges and muff couplings	Forgings	3.7
		Castings	3.8
2	Rudder axles including flanges	Forgings	3.7
		Castings	3.8
3	Rudder plate components	Forgings	3.7
		Castings	3.8
		Rolled plates	3.2
4	Pintles of rudders	Forgings	3.7
		Castings	3.8
5	Fasteners (bolts, nuts)	Rolled stock	3.2
6	Towing hooks with fastenings for their securing to the ship's hull	Fastenings	3.7
		Rolled plates	3.2
7	Anchors	Forgings	3.7
		Castings	3.8
		Rolled plates	3.2
8	Chain cables	Rolled stock	3.6
		Castings	3.8

Notes: 1. Application of other materials for the said blanks is subject to special consideration by the Register in each case.

2. Steel fastenings may be replaced by steel round bars up to 150 mm in diameter.

3. Amount of testing is given according to Section 3, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

1.3.6 The following equipment, arrangements and outfit are subject to the Register technical supervision when the ship is under construction:

.1 rudder and steering gear;

.2 anchor arrangement;

.3 mooring arrangement;

.4 towing and pushing arrangements;

.5 wheelhouse vertical movement arrangement;

.6 life-saving appliances and launching appliances;

.7 closing appliances of openings in hull, superstructures and deckhouses;

.8 miscellaneous arrangements and equipment of the ship's spaces;

.9 emergency outfit;

.10 signal means.

1.3.7 Once the life-saving appliances and launching appliances have been installed on board the ship, the arrangements are to be such that these life-saving appliances and launching appliances pass successfully the tests prescribed by Appendix 1.

1.4 GENERAL

1.4.1 Ice strengthenings provided for in the present Part of the Rules are specified with reference to category **Ice**.

1.4.2 On ships intended for the carriage of flammable liquids with the flash point 55 °C and below in bulk (refer to 1.2, Part V "Fire Protection") no deck machinery is to be fitted directly on the decks being the top of cargo tanks and bunkers.

In this case, the deck machinery is to be fitted on special foundations, the construction of which provide for free circulation of air underneath the machinery.

1.5 WORKING AND ALLOWABLE STRESSES

1.5.1 Wherever the working stresses are mentioned in the text of the present Part, they mean combined stresses σ_{com}, in MPa, determined by the following formula:

$$\sigma_{com} = \sqrt{\sigma^2 + 3\tau^2} \qquad (1.5.1)$$

where σ = normal stresses in the section under consideration, in MPa;
τ = shear stresses in the section under consideration, in MPa.

Strength conditions are to be checked against these stresses.

1.5.2 Allowable stresses with which the combined stresses are to be compared when verifying the strength conditions are specified in the present Part in fractions of the yield stress of the material used; the yield stress is not to be taken more than 0,7 times the ultimate strength of this material, unless expressly provided otherwise.

2 RUDDER AND STEERING GEAR

2.1 GENERAL

2.1.1 Every ship, except pushed shipborne barges, floating structures and berth-connected ships which are permanently in operation near the land or being moored up, is to be provided with a reliable steering gear ensuring her steering, manoeuvrability and course-keeping qualities.

Moreover, rudder and steering gear of ships intended for pushing are to rapidly and readily produce considerable alterations of the course as well as rapidly and readily turn the push-train proceeding downstream or upstream.

The steering system as a whole is to be designed for permanent lists of up to 15°, trims up to 5° and temperatures from −20 °C to + 40 °C.

2.1.2 The requirements of the present Section apply only to ordinary streamlined or plate rudders or nozzle rudders without stabilizers.

Unordinary rudders, nozzle rudders with steerable stabilizers, Voith-Schneider propellers, etc. are subject to special consideration by the Register in each case.

2.1.3 Couplings of the rudder stock with the rudder plate (rudder nozzle) not given in the present Section are subject to special consideration by the Register.

2.1.4 Every assembly and component being part of the rudder and steering gear as well as various parts of machinery not specified in the present Section are to comply with the standards recognised by the Register and with the requirements of Part VIII "Machinery".

2.1.5 Active means of the ship's steering (AMSS).

2.1.5.1 Definitions and explanations as well as the requirements for construction and design of AMSS, excluding separate nozzle rudders and steering system of active rudders, are given in Section 7, Part VI "Machinery Installations".

2.1.5.2 Active means of the ship's steering may be both the means supplementary to the regulated minimum according to 2.1.1 and the main means of the ship's steering.

2.1.5.3 Taking into account the ship's purpose, design features and intended service conditions it may be allowed, on agreement with the Register, that the regulated steerability of the ship is provided at low speed by simultaneous operation of the devices specified in 2.1.1 and AMSS.

In case where the AMSS are the main means of the ship's steering the regulated steerability (refer to 2.9.6) is to be ensured under those running conditions of the ship for which the means are intended.

2.2 INITIAL DESIGN DATA

2.2.1 The initial design data specified in the present Section are valid only for the choice of scantlings of ordinary rudders and nozzle rudders and cannot be used for determination of steering gear output characteristics.

Methods of determination of these characteristics are not regulated by the Register, and the relevant calculations are not subject to the Register approval. The said characteristics of the steering gear are checked by the Register only during sea trials of the ship for compliance with the requirements of 2.9.

2.3 RUDDER

2.3.1 The thickness of the streamlined rudder blade side plating s, in mm, is to be determined by the following formula:

$$s = mk\sqrt{(1{,}18v^2 + 245d)/R_{eH}} \qquad (2.3.1\text{-}1)$$

where m = distance between horizontal or vertical web plates whichever is less, in m;
k = factor given in Table 2.3.1;
v = speed of the ship according to 2.4.1;
d = minimum draught of the ship, in m;
R_{eH} = upper yield stress of the material used, in MPa.

Table 2.3.1

n/m	1	1,2	1,6	2	3
k	5,5	6,2	6,8	7,0	7,1

Note. n = distance between horizontal or vertical web plates whichever is the greater, in m.
For intermediate values of n/m the factor k is determined by linear interpolation.

In any case, the thickness of the rudder blade side plating s, in mm, is to be not less than that determined by the following formula:

$$s = 0{,}6\sqrt{L} \qquad (2.3.1\text{-}2)$$

where L = length of the ship, in m,

but not less than 3 mm.

2.3.2 The streamlined rudders are to be provided with top and bottom plates, the thickness of which is to be not less than 1,4 times the side plating thickness according to 2.3.1.

2.3.3 The rudder blade side plating is to be stiffened from inside by horizontal and vertical web plates. The thickness of the web plates is to be not less than that of the rudder blade side plating according to 2.3.1.

Horizontal and vertical web plates are to be provided with sufficient number of openings for free drainage of water which may penetrate inside the rudder blade. The top and bottom plates are to be fitted with drain plugs of corrosion-resistant material.

The rear edge of the rudder blade is to be rigidly fixed in the proper way.

2.3.4 Side plating and web plates are to be welded together by fillet or plug welds on the permanent backing with slots of linear form. The width of the slots is to be at least twice the rudder blade side plating thickness, and the length is to be not less than 50 mm. The distance between the slots is to be not less than 150 mm. The throat thickness of fillet and plug weld is to be not less than 0,5 of plate thickness. In general, the ends of slots are to be made semicircular. Complete filling of slot is not allowed.

2.3.5 Where the rudder blade is coupled with the rudder stock by means of horizontal flanges, then among other connections between the flange and rudder blade, one vertical web plate is to be fitted under the fore and rear edges of the flange. The fore web plate is to extend, at least, to the mid-height of the rudder blade and the aft web plate is to extend along the entire height of the rudder blade.

The thickness of each web plate is to be at least twice the rudder blade plate thickness according to 2.3.1.

2.3.6 The plate rudder plating thickness s, in mm, is to be determined by the following formula:

$$s = 1{,}25\sqrt{L} \qquad (2.3.6)$$

where L = length of the ship, in m,

but not less than 5,5 mm.

2.3.7 In case of plate rudders, the section modulus W, in cm^3, of each horizontal web plate without effective flange, directly in way of the rotation axis, is to be not less than that determined by the following formula:

$$W = 94{,}2tl_1^2v^2/R_{eH} \qquad (2.3.7)$$

where t = distance between the rudder web plates, in m;
l_1 = distance from the rudder back edge to the rotation axis, in m;
v = maximum speed of the ship according to 2.4.1;
R_{eH} = upper yield stress of the material used, in MPa.

For rudders of barges the above section modulus may be reduced by 20 per cent.

In way of the back edge of the rudder, the thickness of horizontal web plates may be reduced gradually by half.

2.3.8 On ships having an ice category mark **Ice** added to its class notation, the rudder blade side plating thickness determined in accordance with 2.3.1 or 2.3.6 as well as the section modulus of stiffening horizontal web plates determined in accordance with 2.3.7 are to be increased by 10 per cent.

2.3.9 For tugs and pushers, the rudder side plating thickness determined in accordance with 2.3.1 or 2.3.6 and increased in accordance with 2.3.8 is to be increased additionally by 10 per cent, while the section modulus of stiffening web plates determined in accordance with 2.3.7 is to be increased additionally by 20 per cent.

2.3.10 For rudders not arranged behind the propeller as well as for rudders of barges the thickness of the rudder blade side plating determined in accordance with 2.3.1 or 2.3.6 may be reduced by 10 per cent.

2.3.11 Arrangement of rudders above the molded base is to be such as to preclude damage thereof due to impact against the river bed if the ship is in operation with a trim by stern.

2.4 RUDDER STOCK

2.4.1 The diameter of the rudder head d_0, in cm, is to be not less than that determined by the following formula:

$$d_0 = 8{,}65\sqrt[3]{Ar_1v^2/R_{eH}} \qquad (2.4.1\text{-}1)$$

where A = area of the rudder (nozzle) blade, in m^2; for nozzle rudders the value of A is to be taken not less than 1,35 times the side projection area;
r_1 = distance between the centre of gravity of the rudder (nozzle) blade area and the rotation axis, in m; r_1 is to be not less than 1/3 of the mean distance between the rotation axis and the back edge of the rudder (nozzle) blade (refer to Fig 2.4.1);

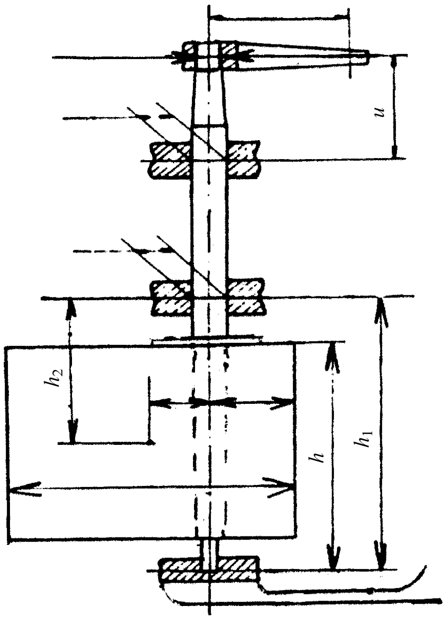


Fig. 2.4.1

R_{eH} = upper yield stress of the rudder stock material, in MPa;
v = maximum ahead speed of the ship, in km/hr, but not less than that determined by the following formula:

$$v = 10\sqrt[3]{P/\Delta^{2/3}} \qquad (2.4.1\text{-}2)$$

where P = total shaft power at the rated power of main engines, in kW;
Δ = displacement of the ship at loaded draught, in m^3.
For pushers, the sum of displacements of the pusher and the largest barge or train intended to be pushed is to be taken.
For non-self-propelled ships, the speed v is to be taken not less than 8 km/hr.

For rudders arranged behind the propeller, the diameter do is to be increased in accordance with 2.4.4.

The diameter of the rudder stock head determined by the Formula (2.4.1-1) and increased in accordance with 2.4.4 is to be taken to determine scantlings of the steering gear components according to 6.2, Part VIII "Machinery".

2.4.2 The diameter of the rudder (nozzle) stock with a support in the solepiece d_1, in cm, at the bottom bearing level is to be not less than that determined by the following formula:

$$d_1 = 0{,}58 d_0 \sqrt[3]{c_1/r_1} \qquad (2.4.2\text{-}1)$$

where for d_0, r_1 = refer to 2.4.1;

$$c_1 = \sqrt{c_2^2 h^2 + 48 r_1^2}\ ; \qquad (2.4.2\text{-}2)$$

$$c_2 = 2 - (h/h_1)^2 \qquad (2.4.2\text{-}3)$$

where h = distance from the middle of the rudder stock bearing or the rudder (nozzle) pintle in the sternframe to the top edge of the rudder (nozzle) blade, in m (refer to 2.4.1);
h_1 = distance from the middle of rudder bearing or pintle in the sternframe to the middle of the bottom rudder stock bearing above the rudder (nozzle), in m (refer to 2.4.1).

2.4.3 The diameter of the balanced hinged rudder (hinged nozzle) stock d_2, in cm, is to be not less than that determined by the following formula:

$$d_2 = d_0 \sqrt[3]{c_3/r_1} \qquad (2.4.3\text{-}1)$$

where for d_0, r_1 = refer to 2.4.1;

$$c_3 = \sqrt{1{,}33 h_2^2 + r_1^2} \qquad (2.4.3\text{-}2)$$

where h_2 = distance from the centre of gravity of the rudder blade area (side projection of nozzle) to the middle of the bottom rudder stock bearing, in m (refer to Fig. 2.4.3).

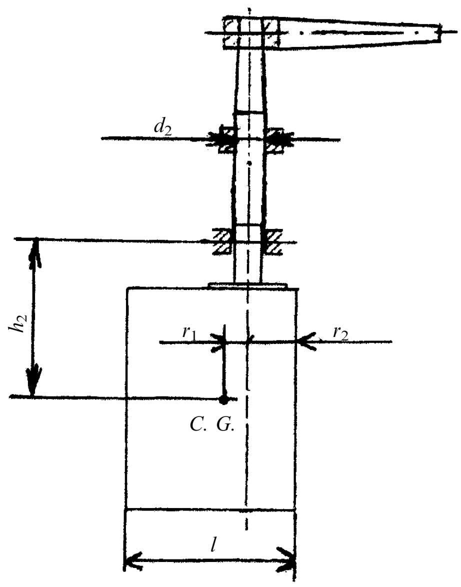


Fig. 2.4.3

2.4.4 The stock diameter of the rudder arranged behind the propeller is to be increased as against the design one by a value in per cent determined by the following formula:

$$24(R/(1 - r_2))^3(1 - 2r_2/l) \qquad (2.4.4)$$

where R = radius of the propeller but not more than $(l - r_2)$, in m;
l = mean width of the rudder blade, in m (refer to Fig. 2.4.1);
r_2 = distance from the rotation axis to the leading edge of the rudder blade at the level of the centre of gravity of its area, in m (refer to Fig. 2.4.1).

2.4.5 The stock diameter of the rudder arranged behind the propeller nozzle is to be increased additionally by 10 per cent over the increase in accordance with 2.4.4.

2.4.6 On ships having the ice category mark **Ice** added to their class notation, the diameter of the rudder stock is to be increased by 10 per cent irrespective of any increases in accordance with 2.4.4 and 2.4.5.

2.4.7 In multiple-screw ships (with two or more propellers), the stock diameter of all rudders may be reduced by 5 per cent.

2.4.8 The diameter of the rudder stock d_3, in cm, in way of the top bearing arranged below the tiller or quadrant of the steering engine is to be not less than that determined by the following formula:

$$d_3 = d_0\sqrt{c_4} \quad (2.4.8\text{-}1)$$

where d_o = diameter of the rudder stock head according to 2.4.1 with due account of the increases in accordance with 2.4.4 and 2.4.5;

$$c_4 = 1{,}15\sqrt{(u/f)^2 + 0{,}75} \quad (2.4.8\text{-}2)$$

where f = radius of the tiller, in cm (refer to Fig.2.4.1);
u = distance from the middle of the top rudder stock bearing to the middle of the tiller or quadrant of the steering engine, in cm (refer to Fig. 2.4.1).

Moreover, the diameter of the rudder stock d_3 is to be checked for the action of the greatest force and the greatest torque which are produced by the steering gear in case of rudder (nozzle) jamming, using the following formula:

$$d_3 = 22\sqrt[3]{M_2 c_4 / R_{eH}} \quad (2.4.8\text{-}3)$$

where M_2 = maximum torque developed by the steering gear in case of rudder jamming, in kN·m.

With the availability of devices which exclude such redistribution of the steering gear load whereby the force on an individual rudder stock exceeds the rated torque, the check using the Formula (2.4.8-3) may be omitted.

The diameter of the rudder stock d_3 on the portion u from the top bearing to the lower edge of the tiller or quadrant may be reduced gradually down to the diameter d_0.

The diameter d_3 may be reduced gradually from the top rudder stock bearing down to the diameter of the bottom bearing arranged directly thereunder, if the distance between these bearings exceeds u.

If the distance between these bearings is less than u, the diameter d_3 may be reduced in such a way that the value of the diameter d_1 or d_2, including the appropriate increases, can be reached only at the distance equal to u.

2.4.9 The diameter of the rudder stock d_1 and d_2 with due account of the appropriate increases may be reduced gradually on the portion above the bottom bearing arranged above the rudder blade. Such reduction is to be made from the bottom bearing to the upper end of the rudder stock in the following way:

.1 in case of the rudder with a support in the sternframe, the diameter d_1 may be reduced gradually over the entire portion between the rudder trunk bearing and the lower edge of the top bearing but not less than to do with due account of strenghtenings;

.2 in case of the hinged rudder, the diameter d_2 is to remain unchanged on the portion equal to 0,2 times the distance from the middle of the rudder trunk bearing to the middle of the bearing arranged thereunder, and from this point on, it may be reduced down to do with due account of increases at the level of top bearing lower edge.

If the rudder stock is carried to the lower edge of the rudder blade, the diameter of the lower end of the rudder stock may be reduced:

down to $0{,}6d_1$ — in case of the rudder with a support on the sternframe;

down to $0{,}4d_2$ — in case of the hinged rudder.

The transition from one rudder stock diameter to another is to be carried out gradually with fillet radii as great as possible.

The transition of the rudder stock into the flange for coupling with the rudder blade is to be carried out with a radius of fillet of not less than 0,12 times the diameter of the rudder stock in way of the flange.

2.5 COUPLINGS

2.5.1 If the rudder stock is coupled with the rudder (nozzle rudder) blade by means of horizontal flanges, the diameter of coupling bolts d_4, in cm, is to be not less than that determined by the following formula:

$$d_4 = 0{,}61d\sqrt{1/z} \quad (2.5.1)$$

where d = diameter of the rudder stock according to 2.4.2 or 2.4.3 taking into consideration the appropriate increases;
z = number of coupling bolts.

The distance from the axis of any bolt to the centre of the system of bolts is to be not less than $0{,}7d$.

For hinged rudders (nozzle rudders) the distance from the axis of any bolt to the centre of the system of bolts is to be not less than 0,6 times the rudder stock diameter in way of bearing arranged above the rudder blade.

2.5.2 Only fitted bolts are to be employed, except the cases of key setting when it is sufficient to have only two fitted bolts. Nuts are to have standard sizes and be efficiently secured.

2.5.3 The thickness of coupling flanges is not to be less than the diameter of coupling bolts d_4. The axes of coupling bolts are to be distant from the outside edges of the flange by not less than 1,2 times the diameter of the bolts.

Coupling flanges of nozzle rudders are to be welded into the nozzle rudder body.

2.5.4 Where the coupling of the rudder stock with the rudder blade is a keyed cone coupling, the taper length of the rudder stock l (refer to Fig. 2.5.4) fitted to the rudder (nozzle rudder) blade is not to be less than 1,5 times the diameter of the rudder stock d, and the taper is to be from 1:10 to 1:12 on the diameter.

The taper is to change into the cylindrical portion without any step in the diameter.

A key is to be set on the cone generatrix.

The working sectional area of the key A_F (product of the key length by its width), in cm^2, is to be not less that that determined by the following formula:

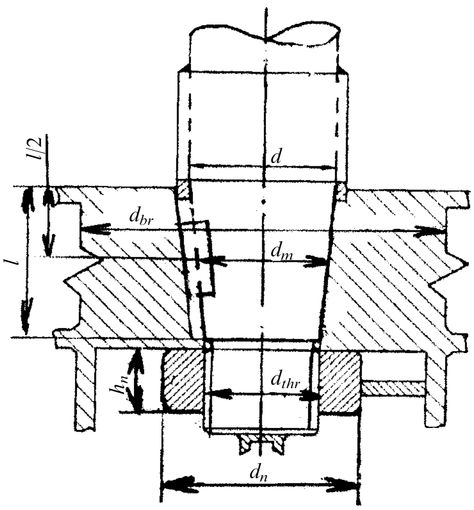


Fig. 2.5.4

$$A_F = \frac{16 M_t}{d_m R_{eH1}} \; 10^3 \qquad (2.5.4\text{-}1)$$

where M_t = rated torque acting on keyed coupling, in kN·m;
d_m = diameter of the tapered end of the rudder stock at the middle of the key length, in mm;
R_{eH1} = yield stress of the key material, in MPa;
The rated torque M_t is to be taken not less than that determined by the following formula:

$$M_t = 0{,}02664 d^3 \eta \qquad (2.5.4\text{-}2)$$

where d = diameter of the rudder stock according to 2.4.2 or 2.4.3 taking into consideration the appropriate increases, in mm;
h = utilization factor of the mechanical properties of the material, to be taken equal to:

$$\eta = (R_{eH}/235)^{0,75} \text{ for } R_{eH} > 235 \text{ MPa}; \quad \eta = (R_{eH}/235) \text{ for } R_{eH} \leqslant 235 \text{ MPa} \qquad (2.5.4\text{-}3)$$

where R_{eH} = upper yield stress of the rudder stock material, in MPa.

The height of the key is to be not less than half its width. The keyway of the rudder stock is not to be confined to the tapered coupling.

2.5.5 The sectional area of the key of the tapered coupling a_k, in cm^2, is to be not less than that determined by the following formula:

$$a_k = \frac{5 M_t}{d_m R_{eH2}} \; 10^3 \qquad (2.5.5)$$

where for M_t and d_m = refer to 2.5.4;
R_{eH2} = yield stress of the rudder stock, key or bracket (boss) material in way of tapered coupling, whichever is less.

2.5.6 The external diameter d_{br} of the rudder (nozzle) bracket (boss) in way of tapered coupling is not to be less than 1,7 times the diameter of the taper in the middle part thereof.

2.5.7 The external diameter d_{thr} of the rudder stock threaded portion is not to be less than 0,9 times the minimum diameter of the taper. The thread is to be fine.

2.5.8 The outer diameter d_n and the height h_n of the nut are not to be less than 1,5 and 0,8 times the external diameter of the taper threaded portion, respectively.

To prevent self-unscrewing, the nut is to be securely fastened.

2.5.9 Where the rudder stock is not made of a solid piece, its parts are to be joined by at least 8 coupling bolts.

The total cross-sectional area of the bolts is to be not less than $0{,}44dz^2$, where d is the rudder stock diameter at the junction.

The thickness of each flange of the muff coupling is to be not less than 0,3 times the rudder stock diameter at the junction.

The axes of the holes for muff coupling bolts are to be distant from the outside edges of the flanges by not less than 1,2 times the diameter of the bolts.

Key is to be provided to relieve the bolts.

2.6 RUDDER PINTLES

2.6.1 The diameter d_5, in cm, of pintles without liners , as well as pintles with liners, but before their setting, is to be not less than that determined by the following formula:

$$d_5 = 8{,}54\sqrt{R_x/R_{eH}} + 2{,}5 \qquad (2.6.1\text{-}1)$$

where R_x = support reaction determined depending on the type of rudder (nozzle) by distribution of the design load R over the rudder (nozzle) blade on each support in conformity with the position of the centre of gravity of the rudder (nozzle) blade in relation to each support, in kN;
R_{eH} = yield stress of the pintle material, in MPa.
The design load R, in kN, on the rudder blade is to be taken not less than that determined by the following formula:

$$R = 0{,}039 A v^2 \qquad (2.6.1\text{-}2)$$

where for A and v = refer to 2.4.1; in this case, for the rudders arranged behind the propellers the speed of the ship is to be taken increased by 30 per cent.

The design load on the rudder nozzle is to be determined in accordance with 2.8.1.

2.6.2 The length of the taper part of the pintle in rudder bracket (boss) or in the solepiece is not to be less than the diameter of the pintle determined by the Formula (2.6.1-1). The taper on the diameter is to be from 1:10 to 1:12.

The taper is to change into cylindrical portion without any step in the diameter. The length of the working cylindrical part of the pintle is to be not less than the pintle diameter with liner and not more than 1,3 times the diameter.

2.6.3 For ships having the ice category mark **Ice** added to their class notation, the diameter of pintles is to be increased additionally by 10 per cent.

For tugs and pushers, the diameter of pintles is to be increased additionally by 10 per cent.

2.6.4 The external diameter of the pintle threaded portion is not to be less than 0,8 times the minimum diameter of the taper. The thread is to be fine.

2.6.5 The outer diameter and height of the nut are to be not less than 1,5 and 0,6 times the external diameter of the pintle threaded portion.

To prevent self-unscrewing, the nut is to be securely fastened.

2.6.6 The thickness of material in the rudder bracket (boss) and in the solepiece as well as in welded-in bushes of the nozzle rudders outside the hole is to be not less than 0,35 times the diameter of the pintle without liner.

2.6.7 The chosen dimensions of pintles are to be checked by the surface loading p, in MPa, determined by the following formula:

$$p = 10R_x/dh_b \qquad (2.6.7)$$

where R_x = support reaction according to 2.6.1;
d = diameter of the pintle including its liner where fitted, but without increases according to 2.6.3;
h_b = height of the pintle bush, in cm.

This surface loading is not to exceed the values specified in Table 2.6.7.

Table 2.6.7

Material of bearing surfaces	Surface loading p, in MPa, during lubrication	
	Water lubrication	Oil lubrication
Stainless steel or bronze against lignum vitae	2,4	-
Stainless and wear-resisting steel against synthetic material[1] of moderate hardness	2,5	-
Steel against white metal	-	4,4
Stainless and wear-resisting steel against synthetic material1 with $HR \geqslant 80^2$	$5{,}5^2$	On special agreement with the Register
Stainless or wear-resisting steel against bronze or vice versa	6,9	On special agreement with the Register
Steel against steel[3]	$7{,}0^3$	-
Stainless and wear-resisting steel against hot formed graphite-bronze material	7,0	-

Notes: 1. Synthetic materials are to be of the approved type.
2. Hardness test is to be carried out at the temperature of 23 °C and at the humidity of 50 per cent in accordance with the standard recognized. The surface loading p exceeding 5,5 MPa may be alowed in accordance with the manufacturer's data and test results, but in any case it is to be not more than 10 MPa.
3. Stainless and wear-resisting steel in the approved combination with the rudder stock liner. The surface loading p in excess of 7,0 MPa is to be confirmed by tests.

The use of the materials different from those specified in Table 2.6.7 for bearing surfaces is to be subject to special consideration by the Register based on satisfactory test results.

2.7 RUDDER STOCK BEARINGS

2.7.1 The height of the bearing bush is to be not less than the external diameter and not more than 1,2 times the said diameter.

2.7.2 The requirements of 2.6.7 for pintles are applicable to the rudder stock bearings taking the lateral load.

2.7.3 A rudder carrier is to be installed to take the mass of the rudder or nozzle rudder and rudder stock. The hull of the ship is to be sufficiently strengthened in way of rudder carrier.

Measures are to be taken against axial displacement of the rudder blade or nozzle rudder and rudder stock upwards by a value exceeding that permitted by the construction of the steering gear; furthermore, for nozzle rudders measures are to be taken to provide for guaranteed clearance between propeller blades and inner surface of nozzle under service conditions.

2.7.4 In case where hinged rudders are installed, the bottom bearing is to be efficiently strengthened in the hull of the ship in longitudinal and transverse directions.

2.7.5 A stuffing box is to be fitted in way of passage of the rudder stock through the top of a rudder trunk to prevent water from penetrating the ship's hull. The stuffing box is to be fitted in a place accessible for inspection and maintenance at all times.

Where the rudder trunk is carried above the freeboard line, the stuffing box may be omitted.

2.8 NOZZLE RUDDERS

2.8.1 The design loading F_l, in kN/m^2, acting on the nozzle rudder is to be taken not less than that determined by the following formula:

$$F_l = cF_{l0} \qquad (2.8.1\text{-}1)$$

where $F_{l0} = \varepsilon N/A_p$, in kN/m^2, (2.8.1-2)
N = maximum shaft power, in kW;
A_p = propeller disk area, in m^2;
ε = factor determined by the following formula:
$\varepsilon = 0{,}21 - 2\cdot10^{-4}N/Ap$, but not less than 0,1; (2.8.1-3)
c = factor equal to:
1,0 in zone 2 (propeller zone);
0,5 in zones 1 and 3;
0,35 in zone 4 (refer to Fig. 2.8.1).

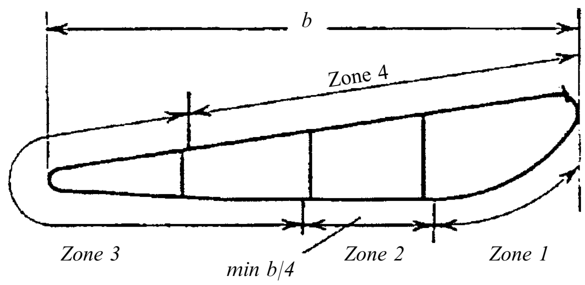


Fig. 2.8.1

2.8.2 The propeller disk area, in m^2, is to be not less than that determined by the following formula:

$$A_p = \pi D^2/4 \qquad (2.8.2)$$

where D = diameter of the propeller, in m.

2.8.3 The thickness of the nozzle rudder plating t, in mm, is to be not less than that determined by the following formula:

$$t = 5a\sqrt{F_l} + 1{,}0 \qquad (2.8.3)$$

where a = distance between transverse ring web plates, in m,

but not less than $t_{\min}$ = 7,5 mm.

In case of application of stainless or clad steel the value of t in zone 2 (propeller zone) may be reduced on agreement with the Register.

2.8.4 The outside and inside plating of the nozzle rudder are to be stiffened from the inside by transverse and longitudinal web plates.

In zone 2 (propeller zone) of the inside plating of the nozzle rudder, at least two continuous transverse ring web plates are to be fitted.

Web plates thickness is to be not less than that of the nozzle rudder plating within zone 3, but no less than 7,5 mm.

2.8.5 The section modulus W, in cm^3, of the nozzle rudder given in Fig. 2.8.1 about its neutral axis is to be not less than that determined by the following formula:

$$W = 0{,}35 d_{in} b v^2 \qquad (2.8.5)$$

where d_{in} = internal diameter of the nozzle rudder, in m;
v = speed of the ship according to 2.4.1, in km/hr;
b = length of the nozzle rudder, in m.

2.8.6 Transverse and longitudinal web plates are to be provided with sufficient number of openings for free drainage of water which might penetrate inside the nozzle rudder, and in the lower and upper parts of the outside plating drain plugs of stainless steel are to be fitted.

2.8.7 Transverse and longitudinal web plates are to be welded to the nozzle rudder inside plating by continuous fillet welds.

Plug welding according to 2.3.4 is allowed only for the nozzle rudder outside plating.

2.9 STEERING GEAR

2.9.1 Each ship is to be provided with main and auxiliary steering gear, except for cases specified in 2.9.2.

Main and auxiliary steering gear are to act independently of one another. But they may have some common structural components, such as tiller, quadrant, gear box, cylinder block.

2.9.2 Auxiliary steering gear is not required on ships:

.1 with hand-operated main steering gear;

.2 with several rudders actuated by separately operated steering engines;

.3 with a single electro-hydraulic steering engine when two independent power units are provided.

2.9.3 Steering gear may be hand-operated provided the rudder stock head diameter do, determined according to 2.4.1 does not exceed 150 mm.

In steering arrangements with multi-blade rudders and common steering gear the said diameter is to be determined by the following formula:

$$d_0 = \sqrt[3]{d_{01}^3 + d_{02}^3 + \ldots + d_{0n}^3} \qquad (2.9.3)$$

where n = number of rudders.

2.9.4 Hand-operated hydraulic steering gear is to be considered as the only steering gear which does not require the provision of the auxiliary steering gear provided that the size, construction and arrangement of piping eliminate the possibility of their mechanical damage or damage due to fire.

2.9.5 Where the steering arrangement is provided with a hand-operated steering gear, each full turn of the steering wheel is to correspond to shifting of the rudder to an angle not less than 3°.

The force to be applied to the steering wheel for turning is not to exceed 160 N.

2.9.6 The power-operated steering gear is to be capable of shifting the rudder or nozzle rudder with an angular speed not less than 4° per second when putting the rudder or nozzle rudder at least 30° to each side from the centre line of the ship running ahead at the maximum speed with fully immersed rudder or nozzle rudder.

Considering the navigation conditions on particular waterways, the Register may allow a lesser angular speed of the rudder shifting, provided it will be at least 2,5° per second.

Besides, the main power-operated steering gear is to be capable of putting the rudders from hard over to hard over with the ship running astern at full speed.

2.9.7 Auxiliary steering gear is to be capable of putting the rudder or nozzle rudder over from 20° on one side to 20° on the other side in not more than 60 s with the fully immersed rudder or nozzle rudder, when the ship is running ahead at half the maximum speed.

2.9.8 Where the auxiliary hand-operated steering gear is a hand-operated hydraulic steering gear, then in case of shut-down or failure of the power-operated main steering gear it is to be actuated automatically or arrangements are to be made to ensure its immediate actuation from the control station. On agreement with the Register, the force equal to 160 N to be applied to the steering wheel handles may be increased.

2.9.9 If the auxiliary steering gear is not actuated automatically in case of failure of the main steering gear, provision is to be made for its immediate and simple actuation by hand in any position of the rudder.

2.9.10 Time required to change over from the main steering gear to the auxiliary steering gear is not to exceed 5 s.

2.9.11 Light alarm is to be provided on control panels to indicate the operation of the steering gear and to show what steering gear is actuated.

In case of any troubles in the operation of steering gears a visual and sound signals are to be transmitted to the control station according to 5.5.7, Part IX "Electrical Equipment".

2.9.12 A rudder (nozzle rudder) blade angle indicator is to be fitted in the wheelhouse and in all control stations.

The rudder blade angle indicator is to be fitted also on the steering engine.

2.10 RUDDER OR NOZZLE RUDDER STOPS

2.10.1 The steering arrangements are to be provided with a system of stops permitting to put the rudder or nozzle rudder over either side only to an angle β° which is to meet the following condition:

.1 for hand-operated steering gear

$$(\alpha^0 + 1) \leqslant \beta^0 \leqslant (\alpha^0 + 1{,}5); \qquad (2.10.1\text{-}1)$$

.2 for power-operated steering gear

$$(\alpha^0 + 2) \leqslant \beta^0 \leqslant (\alpha^0 + 3) \qquad (2.10.1\text{-}2)$$

where α° = hard-over angle to which the steering engine is adjusted.

2.10.2 All components of the system of stops, including those which are in the same time the components of the steering gear, are to be meant for forces corresponding to the ultimate torque M_t in N.cm, of not less that that determined by the following formula:

$$M_t = 11{,}54 d_0^3 R_{eH} \qquad (2.10.2)$$

where d_0 = diameter of the rudder stock head according to 2.4.1, in cm;
R_{eH} = upper yield stress of the rudder stock material, in MPa.

The stresses in these parts are not to exceed 0,95 times the upper yield stress of their material.

3 ANCHOR ARRANGEMENT

3.1 GENERAL

3.1.1 The requirements of the present Section apply to anchor arrangements of self-propelled and non-self-propelled ships as well as to push-trains.

3.1.2 Each ship, except cases specified in 3.1.3, is to be provided with anchor arrangement always ready for use, which is to ensure reliable riding of the ship at anchor.

3.1.3 Berth-connected ships operated permanently near the land as well as pushed ships which make short voyages, on agreement with the Register, may not be fitted with anchor arrangement provided their safety is ensured by other means recognized by the Register as adequate.

If, proceeding from the local navigation conditions on particular waterways, anchor equipment is considered to be necessary it is to be selected as for non-self-propelled ships.

3.1.4 As far as the anchor equipment is concerned, self-propelled industrial ships are to be considered equal to non-self-propelled ships.

3.1.5 Anchor arrangement to be provided on shipborne barges, floating structures of special purpose, non-self-propelled industrial ships, ships of unusual design as well as ordinary ships intended exclusively for operation under special conditions is subject to special consideration by the Register in each particular case.

3.1.6 If a ship in addition to the anchor arrangement or equipment specified in 3.1.3, 3.1.4 and 3.1.5 is provided with some other anchor arrangement or equipment (e.g. special anchors on dredgers, mooring anchors on floating docks, etc.) such anchor arrangement or equipment is regarded as special one and is not subject to the Register supervision.

3.1.7 The requirements of the present Section are specified for anchors of normal holding power (Hall's anchors or four-fluked anchors). Application of anchors of other types is subject to special consideration by the Register in each case.

3.1.8 In order to recognize the anchor as a high holding power anchor, it is necessary to carry out comparative tests of this anchor and Hall's anchor in pair on various types of ground. In this case, the holding power of the anchor is to be at least twice as much as that of Hall's anchor of the same mass.

The scope and procedure of comparative tests are subject to special consideration by the Register in each case.

3.1.9 Structural measures are to be taken to prevent damage of other ships by anchors located in hawse pipes.

3.1.10 Chain lockers size and design are to provide an unobstructed stowage of the entire anchor chain when self-stowing.

Provision is to be made for a drainage system in chain lockers according to 6.10.5, Part VII "Systems and Piping".

3.1.11 All items of the anchor arrangement are to comply with the standards agreed with the Register.

3.1.12 Control stations of the anchor machinery are to be so located that in case of break of the chain or rope the operating personnel are not be exposed to danger and the anchor chain running through the sprocket is clearly visible.

3.1.13 Working places from which the anchoring operation is performed are to have non-skid coating.

3.1.14 The openings of hawse pipes on open decks are to be fitted with covers.

3.1.15 Cast iron anchors are not permitted.

3.2 SUPPLY OF SHIPS WITH ANCHORS, ANCHOR CHAINS AND CABLES

3.2.1 Anchors of passenger and self-propelled cargo ships.

3.2.1.1 Self-propelled cargo ships (dry cargo ships and tankers) are to be provided with bow anchors the total mass of which M_A, in kg, is to be not less than that determined by the following formula:

$$M_A = cBT\sqrt{L/(8B)} \tag{3.2.1.1}$$

where c = empirical coefficient;
L = maximum length of the ship, in m;
B = maximum breadth of the ship, in m;
T = maximum permissible draught, in m.
The empirical coefficient value is determined in accordance with values given in Table 3.2.1.1.

Table 3.2.1.1

Cargo-carrying capacity of the ship, in t	Coefficient c	
	Area of navigation 3	Area of navigation 2
up to 400 incluside	35	45
from 400 to 650, inclusive	40	55
from 650 to 1000, inclusive	45	65
over 1000	50	70

Passenger ships are to be equipped with bow anchors whose total mass in kg is calculated using the following Formula (3.2.1.1) and Table 3.2.1.1, using the displacement in m^3 instead of the deadweight tonnage.

3.2.1.2 The total mass M_A for bow anchors according to 3.2.1 may be distributed between one or two bow anchors. If the ship is provided only with one bow anchor and the hawse pipe is located in the centreline of the ship, the total mass may M_A be reduced by 15 per cent.

Where two bow anchors are provided, the total mass of anchors is to be evenly distributed between them; in this case the mass of the lighter anchor is to be not less than 45 per cent of the total mass of anchors.

3.2.1.3 If high holding power anchors are used according to 3.1.8, the total mass M_A in accordance with 3.2.1.1 may be reduced by 25 per cent considering the reduction according to 3.2.1.2.

3.2.1.4 Passenger and self-propelled cargo ships are to be provided with stern anchors the total mass of which is to constitute the following portion in per cent of the greatest mass M_A according to 3.2.1.1:

.1 25 per cent if the length of the ship does not exceed 86 m;

.2 50 per cent if the length of the ship exceeds 86 m.

Stern anchors are not required for ships for which the stern anchor mass will be less than 150 kg.

3.2.1.5 For passenger and self-propelled cargo ships of more than 86 m in length, the total mass of stern anchors may be distributed between one or two anchors.

Where two stern anchors are provided, the anchor mass is to be evenly distributed between two anchors; in this case the mass of the lighter anchor is to amount at least to 45 per cent of the total mass of anchors.

3.2.2 Anchors of other ships.

3.2.2.1 Anchor equipment of ships other than those mentioned in 3.2.1.1 is to be specified according to the Equipment Number N_A, in m^2, determined by the following formula:

$$N_A = L(B + D) + A \tag{3.2.2.1-1}$$

where L, B, D = principal dimensions of the ship according to 1.2.1, in m;
A = correction for superstructures and deckhouses, in m^2, determined by the following formula:

$$A = k\Sigma lh \tag{3.2.2.1-2}$$

where l and h = length and mean height of individual superstuctures and deckhouses, in m;
The calculation of the value A is to include all the superstructures and deckhouses having breadth greater than $B/4$.

Table 3.2.2.1

Equipment Number N_A	Number of anchors	Total mass of bow anchors, in kg
Up to 35	1	35
36 — 65	1	50
66 — 85	1	75
86 — 107	1	100
108 — 131	2	150
132 — 156	2	200
157 — 185	2	250
186 — 236	2	300
237 — 294	2	350
295 — 356	2	400
357 — 417	2	450
418 — 525	2	500
526 — 669	2	600
670 — 840	2	700
841 — 1010	2	800
1011 — 1200	2	900
1201 — 1250	2	1000
1251 — 2080	2	1250
2081 — 2675	2	1500
2676 — 3310	2	1750
3311 — 3990	2	2000
3391 — 4200	2	2250
4201 — 5839	2	2500
5840 — 8050	2	3000
8051 — 11200	2	3500

The coefficient k is taken as equal to:
1 — for ships on which the total length of superstructures and deckhouses arranged on all decks exceeds one-half the length of the ship L;
0,5 — for ships on which the above total length is in the range from $0,25L$ to $0,5L$.
Where the above total length is less than 0,25 L, the correction A is not introduced into the formula.

3.2.2.2 For non-self-propelled ships intended for the carriage of a particular deck cargo, the value of Σlh is to be calculated as a product of the length of side projection of cargo stowed on deck together with cargo bounding boards by the mean height of the cargo.

The coefficient k is taken equal to:

.1 $k = 0,5$ for barges carrying only dry bulk cargo;

.2 $k = 1$ for barges carrying other deck cargoes.

3.2.2.3 On industrial ships main gallows, bucket ladders, chutes and derricks in stowed for sea position are accounted for in the Equipment Number as deckhouses the lateral plane area of which is determined by the outer contour.

3.2.2.4 Anchor equipment of push-trains is selected according to the maximum value of the Equipment Number to be determined for various alternatives of making up the push-trains.

3.2.2.5 For ships in **Zone 2** the number and mass of bow anchors is determined according to Table 3.2.2.1 depending on the Equipment Number by multiplying in this case the tabulated mass of anchors by coefficient k or k_1 taken equal to:

.1 $k = 0,9$, for self-propelled and non-self propelled ships at the current speed up to 6 km/h;

.2 $k = 1,0$, ditto, at the current speed from 6 km/h to 9 km/h;

.3 $k = 1,2$, ditto, at the current speed above 9 km/h;

.4 $k_1 = 1,08$, for tugs and pushers.

For ships in **Zone 3** and **Zone 4** having the Equipment Number less than 325, the mass of anchors is determined by multiplying the tabulated mass of anchors of ships in **Zone 2** (considering the appropriate coefficients k and k_1) by the coefficient $k_2 = 0,8$.

If the current speed within **Zone 3** and **Zone 4** is less than 3,5 km/h, then on agreement with the Register, the coefficient k_2 may be taken equal to 0,6 for all the Equipment Numbers.

In all other cases, not specified above, ships in **Zone 3** and **Zone 4** are to be provided with anchors as ships in **Zone 2**.

3.2.2.6 When determining the mass of each of two anchors to be fitted the total tabulated mass is to be evenly distributed between two anchors; the mass of the lighter anchor in this case is to constitute at least 40 per cent of the total mass of anchors.

3.2.2.7 In pushers, on agreement with the Register, the bow anchor arrangement may be omitted.

3.2.2.8 On sections and shipborne barges operated within the push-trains, bow anchor arrangement is compulsory only for the leading section or barge; the requirement of 3.2.2.4 is to be taken into account.

3.2.2.9 The total mass of bow anchors of two and more coupled leading sections of the push-train is to be distributed between them.

3.2.2.10 On non-self-propelled ships which in accordance with Table 3.2.2.1 are to be provided with two anchors, on agreement with the Register, only one anchor may be installed; in this case, in the towed ships the mass of this anchor is to constitute not less than 75 per cent of the total tabulated mass and on the pushed barges such mass is not to be less than 100 per cent.

3.2.2.11 Pushers and push tugs are to be provided by stern anchors the number and mass of which is specified according to Table 3.2.2.1 depending on the Equipment Number determined considering the requirement of 3.2.2.4, by multiplying in doing so the tabulated mass of anchors by the coefficient $k_3 = 0,75k_1$,where k_1 is taken according to 3.2.2.5.

The obtained total mass of anchors is to be not less than that given in Table 3.2.2.11.

Table 3.2.2.11

Power, in kW	Total mass of stern anchors, in kg
295	600
440	800
735	1000
1105	1250
1620	1500
2355	1750
3680	2000

Note. The intermediate values are determined by linear interpolation with rounding-off to the nearest standard mass of the anchor.

For push tugs with capacity up to 225 kW, on agreement with the Register, the mass of the stern anchor may be reduced, and at the capacity of 110 kW and below and at the length of the ship of 20 m and below stern anchors may be omitted.

3.2.2.12 When using high holding power anchors, the total mass of the bow anchors according to Table 3.2.2.1 may be reduced by 25 per cent considering the provisions of 3.2.2.5, 3.2.2.10 and 3.2.2.11.

3.2.2.13 Stern anchors are not required for pushed barges and for ships for which the stern anchor mass will be less than 150 kg. Installation of the stern anchor arrangement on other self-propelled and non-self-propelled ships is subject to special consideration by the Register in each case.

3.2.3 Anchor chains and cables.

3.2.3.1 Anchor chains are selected according to Table 3.2.3.1.

3.2.3.2 When using high holding power anchors, anchor chains, cables and other components of anchor arrangement are to be selected according to the mass of

Table 3.2.3.1

Mass of anchor, kg	Minimum breaking strength of the anchor chain, in kN	Diameter of anchor chain, in mm			
		Studless chains of grades 1 and 2	Studded chains		
			Grade 1	Grade 2	Grade 3
35	12	6	—	—	—
50	17	7	—	—	—
70	24	9	—	—	—
100	34	10	—	—	—
150	51	12	11	—	—
200	69	14	14	11	—
250	86	16	16	12,5	—
300	103	17	16	14	11
350	121	18	17,5	16	12,5
400	137	20	19	16	14
450	155	21	20,5	17,5	14
500	172	22	20,5	17,5	16
600	206	24	24	19	16
700	240	26	26	20,5	17,5
800	275	28	26	22	19
900	309	29	28	24	20,5
1000	343	31	30	26	20,5
1250	430	34	34	28	24
1500	515	38	36	30	26
1750	601	41	40	34	30
2000	686	43	42	36	30

Notes: 1. Diameters given in the Table have been determined for anchor chains of grades 1, 2 and 3 according to 7.1, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

2. The breaking strength of the jerking-out chain (or cable) is not to be less than 0,3 times the breaking strength of the anchor chain.

the relevant normal holding power anchor specified for the ship concerned.

3.2.3.3 Beginning with the diameter 11 mm and over, it is recommended to use studded anchor chains.

3.2.3.4 The length of each bow anchor chain is to correspond to the values given in Table 3.2.3.4.

Table 3.2.3.4

Length of the ship L, in m	Length of the chain, in m
Up to 30	$\geqslant 40$
from 30 to 50	$\geqslant L+10$
over 50	$\geqslant 60$, but not more than 100

3.2.3.5 The length of stern anchor chains on self-propelled ships is to be not less than 40 m. However, the length of each stern anchor chain on self-propelled cargo ships which are to ride with their head downstream is not to be less than 60 m.

The length of each stern anchor chain on other ships is to be not less than 75 per cent of the length of the bow anchor chain, except for stern anchor chain of pushers and push tugs the length of which is to be not less than that of the bow anchor chain determined for the pushed train.

3.2.3.6 The connection of the anchor with the anchor chain is to withstand a tensile load 20 per cent higher than the breaking strength of the corresponding chain.

3.2.3.7 The use of cables instead of anchor chains is permitted; the cables are to have the same breaking strength as that required for chains and but are to be 20 per cent longer.

3.3 DEVICES FOR STOWING AND SECURING ANCHORS, ANCHOR CHAINS AND CABLES

3.3.1 All ships are to be provided with devices for anchors stowage, such as hawse pipes, as well as stoppers for holding the ship at anchor and devices for securing anchors for sea. Stoppers intended to hold the ship at anchor are to have strength equal to that of anchor chains and may be used to secure anchors for sea. Stoppers are to be so designed as to ensure easy and safe paying out (dropping) and securing the chain and anchor.

3.3.2 Each anchor chain or cable is to be firmly secured by its inboard end to the strengthened part of the chain locker or hull structure and be provided with a device for releasing the inboard end.

On agreement with the Register, the device for releasing the inboard end of the anchor chain or cable may be omitted.

Where the device for releasing the inboard end of the anchor chain or cable is not provided, the anchor chain or cable is to be firmly secured to the ship by means of the end shackle or a similar fixture.

3.3.3 Strength of anchor securing devices components, when the ship is riding at anchor, as well as those of anchor chains and cables and of components for their securing to the ship's hull are to be such that they can withstand a force equal to at least the breaking strength of the chains or cables for which they (components) are designed.

The components of the device for securing and releasing the inboard end of the chain or cable are to withstand a design load equal to 0,6 times the breaking strength of the chain or cable for which they are designed. Stresses in these components are not to exceed 0,95 times the upper yield stress of their material.

3.3.4 Hawse pipes and their arrangement on board the ship are to meet the following requirements:

.1 to ensure free pulling the anchor shank into the hawse pipe and when the anchor chain is paid out, free moving the anchor out under the action of its own weight.

The internal diameter of the hawse pipe is to be not less than 10 anchor chain diameters, and the thickness of the hawse pipe is not to be less than 0,4 times the diameter of the chain.

.2 to ensure the minimum bend of the anchor chain when passing through the hawse pipe.

3.3.5 Chain lockers are to be of sufficient capacity to contain the whole of the anchor chain without difficulty.

3.4 ANCHOR MACHINERY

3.4.1 Anchor machinery is to be fitted on the deck of every ship for dropping and hoisting the anchors of more than 50 kg in mass. The requirements of 1.4.2 are to be taken into consideration.

Hand-operated anchor machinery may be fitted on ships other than pushers, push tugs and pushing cargo vessels which are to be provided with power-operated winches to handle stern anchors.

On agreement with the Register, other deck machinery may be used to handle the anchors.

The requirements for the design and power of anchor machinery are given in 6.3, Part VIII "Machinery".

3.4.2 Hand-operated anchor machinery is to be so fitted that the control handles in their lowest position are situated at a height not less than 500 mm above the deck, and when in their highest position, at not more than 1200 mm above the deck.

3.5 TESTS OF ANCHOR CHAINS

3.5.1 Studded anchor chains are tested in accordance with Table 7.14.1.2-1, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships, while studless anchor chains are tested in accordance with Table 3.5.1.

Table 3.5.1

Chain diameter, in mm	Test load, in kN, for studless chains	
	Grades 1 and 2	
	proof load	breaking load
6	9	13
7	13	18
8	17	24
9	21	30
10	26	37
11	31	45
12	37	53
13	44	62
14	51	72
15	58	83
16	66	95
17	75	107
18	84	120
19	94	133
20	104	148
21	114	163
22	125	179
23	137	195
24	149	213
25	162	231
26	175	250
27	189	269
28	203	289
29	218	310
30	233	332
31	249	355
32	265	378
33	282	402
34	300	427
35	318	452
36	336	478
37	356	505
38	374	533
39	394	561
40	415	591
41	436	621
42	458	652
43	480	683

4 MOORING ARRANGEMENT

4.1 GENERAL

4.1.1 Every ship is to be supplied with mooring arrangement for warping to coastal or floating berths and for reliable fastening of the ship to them.

4.2 EQUIPMENT NUMBER

4.2.1 The Equipment Number N_A is determined in compliance with 3.2.2.1.

4.3 MOORING CABLES

4.3.1 The number of mooring cables on board the ship is to be not less than three. On ships where the length L is less than 20 m, the third cable is not required.

If so desired by the shipowner, the mooring ropes of shipborne barges may be stored in the barge carrier, tug or pusher and form no part of the equipment of the shipborne barge.

4.3.2 The minimum lengths l of the mooring cables, in m, are to be as follows:

.1 first cable: $l = L + 20$, where L is the ships's length in m, but not more than 100;

.2 second cable: two thirds of the first cable;

.3 third cable: one third of the first cable.

4.3.3 The actual breaking strength F_{br}, in kN, of a steel wire mooring cable is to be not less than that determined by the following formula:

$$F_{br} = 0{,}15N_A + 25 \qquad (4.3.3)$$

where N_A = Equipment Number according to 4.2.

However, there is no need for mooring cables with breaking strength F_{br} exceeding 320 kN.

4.3.4 Instead of steel cables, natural or synthetic fibre cables may be used if a minimum tensile strength of a synthetic cable is the same as that of a steel cable, while the minimum tensile strength of a natural fibre cable is 20 per cent higher than that of a steel cable.

4.3.5 On ships carrying flammable liquids with the flash point 55 °C and below, the operations with steel cables are allowed only on superstructure decks which are not top of liquid cargo tanks and on condition that no pipelines for loading and unloading the cargo are carried through these decks and not nearer than 3 m from the liquid cargo tanks.

4.3.6 Steel cables are to have at least 144 wires and not less than 7 fibre cores (flexible structure 6×24+7 fibre cores).

Wires of the cables are to have a zinc coating according to recognized standards.

On agreement with the Register, cables of other construction may be allowed, provided they ensure properties equivalent to those of the above cables.

4.3.7 The requirements for manufacture and tests of the cables are set out in 3.15, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

4.4 MOORING APPLIANCES AND MACHINERY

4.4.1 The number and arrangement of mooring bollards, fairleaders, mooring chocks and other mooring appliances depend on the constructional features, dimensions, purpose and general arrangement of the ship.

4.4.2 The outside diameter of the bollard column is to be not less than 10 diameters of the steel cable, not less than 5,5 diameters of the synthetic fibre cable and not less than one circumference of the natural fibre cable for which the bollard is designed.

The distance between the axes of bollard columns is not to be less than 25 diameters of the steel cable or 3 circumferences of the natural fibre cable.

4.4.3 Bollards may be made of steel or cast iron. For small ships, the equipment of which includes only natural fibre or synthetic fibre cables, the bollards may be made of light alloys. As regards manufacture technique, bollards may be welded or cast.

Upper fittings of the lifting posts of shipborne barges may be used for mooring, provided upper fittings have a specially made end to prevent the cable from being slipped off and meet the requirements of 4.4.2.

4.4.4 Bollards are to be installed on beds secured to the deck or are to pierce the deck and be secured to the hull structure. No cut-in bollards are allowed to be installed directly on the deck which are the top of the tanks used for the carriage or storage of flammable liquids with the flash point 55 °C and below.

Bollards, mooring, chocks, fairleaders and other parts of mooring appliances, as well as their beds are to be so designed that the stresses in the parts do not exceed 0,95 times the upper yield stress of their material when subjected to the strain equal to the actual breaking stress of the mooring cable for which they are intended.

Where grey cast iron is used, the safety margin is to be not less than two.

4.4.5 Mooring appliances are to be so arranged on the deck that a free access thereto is provided when the operations are performed and that they are protected from the moving parts of deck machinery and other devices; the requirements of 1.4.2 are to be taken into account.

Working places around mooring appliances are to be provided with non-skid coatings.

4.4.6 Control stations of mooring machinery are to be so arranged that in case of the cable break, danger to the operating personnel is precluded.

4.4.7 Where mooring operations are performed manually, relative positions and height at which the fairleaders, mooring chocks and bollards are arranged are to ensure safe laying-down of cables, including stowage and normal position of ropes on bollards without laying-over of layers.

Relative positions of bollards, mooring chocks and fairleaders are to be such that the inclination angle of the rope running from bollards to mooring chocks and fairleaders to the horizontal does not exceed 20°.

4.4.8 Arrangement of mooring appliances is to be such as to ensure the cable running at right angle to the rotation axis of mooring machinery.

4.4.9 As regards handles of the hand-operated machinery, the requirement of 3.4.2 is to be complied with.

4.4.10 The choice of the number and type of mooring machinery is within the shipowner's and designer's discretion, provided the rated pull of the machinery is not to exceed 1/3 of the actual breaking strength of the mooring cables used in the ship and, besides, the requirements of 6.4, Part VIII "Machinery" are to be met.

5 TOWING AND PUSHING ARRANGEMENTS

5.1 GENERAL

5.1.1 Every self-propelled and non-self-propelled ship is to be provided with an arrangement which makes it possible, if necessary, to take a ship in tow.

Towing equipment is to be arranged in such a way that its use does not impair the safety of the ship, crew or the cargo.

5.1.2 Ships which have descriptive notations in their class notation are to meet the following requirements of the present Section:

.1 ships having the descriptive notation **Tug** — the requirements of 5.2;

.2 ships having the descriptive notation **Pusher** — the requirements of 5.4;

.3 ships having the descriptive notation **Push tug** — the requirements of 5.2 and 5.4;

.4 ships having the descriptive notation **Cargo push-ship** — the requirements of 5.4.

5.1.3 Towing arrangements of self-propelled ships not mentioned in 5.1.2 are to meet the requirements of 5.5.

5.1.4 Control stations of towing machinery are to be so located that they are situated outside hazardous zone produced by the tow line and hook and that, where possible, the towing equipment is clearly visible therefrom.

5.1.5 Ships suitable for pushing (pushers, push-tugs and cargo push-ships) are to be equipped with:

.1 at least two special winches complying with the requirements of 6.6, Part VIII "Machinery" or equivalent coupling devices so designed as to provide necessary degree of freedom for relative movements of ships during pitching and rolling:

.2 a suitable pushing device at the bow so designed and equipped that, from the start of the coupling manoeuvres:

the ship can take up a fixed position in relation to the pushed barges;

the crew can perform easily and safely the manoeuvres required for coupling the ship to the pushed barges.

The coupling device is to be so positioned on deck as not to interfere with the operation of other deck mechanisms.

5.2 TUGS EQUIPMENT

5.2.1 Tugs are to be provided with arrangement comprising a complex of equipment and machinery to ensure performance of towing operations under various service conditions and in accordance with the waterways on which the tugs are allowed to operate.

The number and type of equipment and machinery of the towing arrangement as well as their location on board are determined by the shipowner and designer considering the dimensions and purpose of the tug, however, on ships steered by cycloidal propellers or similar propulsion units the towing devices are to be installed forward of the propeller plane.

5.2.2 All parts of towing arrangement which are subjected to tension or bending under the pull of the tow line are not to be manufactured of cast iron.

5.2.3 The requirements of 4.4.2 to 4.4.4 for mooring chocks and bollards are also applicable to towing chocks and bollards.

5.2.4 Tow lines.

5.2.4.1 Tugs are to be supplied with tow lines depending on the rated towing pull F at the towing speed $v = 0$.

The rated towing pull F, in kN, is to be taken not less than that determined by the following formulae:

.1 for ships without propeller nozzle

$$F = 0{,}16 P_e; \tag{5.2.4.1-1}$$

.2 for ships fitted with fixed or steering nozzle

$$F = 0{,}2 P_e \tag{5.2.4.1-2}$$

where P_e = total shaft power of the tug, in kW.

Where during mooring and sea trials of the tug the measured rated towing pull F exceeds the design one or the pull assumed from the prototype, the Register may require to strengthen the towing arrangement components or to introduce restriction on the power during towage.

5.2.4.2 The actual breaking strength of each steel wire tow line is to be not less than $3F$, where F is determined according to 5.2.4.1.

5.2.4.3 Tow lines are to be of steel wire. The use of tow lines made of synthetic fibre for towing is subject to special agreement with the Register.

In all other respects steel wire tow lines are to meet the requirements of 4.3.6.

5.2.4.4 The length of the tow line may be determined basing on the service experience, depending on the tug power, dimensions and in accordance with the waterways on which the tug is allowed to operate, but not less than 60 m and not more than 200 m.

5.2.5 Tow hooks.

5.2.5.1 Tow hooks are to be of slip-type and have an emergency tow line releasing device operating efficiently in the range of loads on the tow hook from zero to actual breaking strength of the tow line and at any practically possible deflection of the tow line from the centre line of the ship.

The emergency tow line releasing device is to be controlled both locally at the tow hook and from the wheelhouse.

This requirement does not apply to spare tow hooks.

5.2.5.2 All stressed parts of the tow hook as well as fastenings for securing the hook to the ship's hull are to be designed to take the actual breaking load of the tow line which is used in towing. The stresses in these parts are not to exceed 0,95 times the upper yield stress of their material.

5.2.5.3 Each tow hook is to be provided with shock absorber which ultimate damping load is not to be less than 1,2 times the rated towing pull F.

On agreement with the Register, tow hooks in tugs with power of 75 kW and more may not be provided with shock absorbers.

5.2.5.4 The cramp iron of the tow hook is to be either solid forged or manufactured of a solid rolled blank. Percentage elongation of the cramp iron material is not to be less than 18 per cent on $5D$.

5.2.5.5 The cramp iron of the tow hook is to be calculated as a curvilinear bar. Where such calculations are not made, permissible stresses in the dangerous section are to be reduced by 35 per cent.

5.2.5.6 Prior to installation on board the ship, tow hooks are to be tested by application of a proof load equal to twice the rated towing pull F at towing speed $v = 0$.

5.2.5.7 The tow hook is to be secured to the ship's structure in such a way that at any practically possible towing angles the hook takes only the forces acting in its vertical symmetry plane.

5.2.5.8 Lengthwise, the tow hook is to be located at a distance not less than $0{,}3L$ from the rudder stock axis.

In some cases, on agreement with the Register, this distance may be reduced.

5.2.6 Towing winches.

The requirements for the design of towing winches are specified in 6.5, Part VIII "Machinery".

5.3 EQUIPMENT OF TOWED NON-SELF-PROPELLED SHIPS

5.3.1 Towing arrangement of towed non-self-propelled ships is to generally consist of towing bollards or bitts, chocks and cleats.

At the shipowner's discretion tow hooks secured to the towing bollards may be used.

For coupling the towed ships when trains are made up, mooring bollards may be used.

Upper fittings of the lifting posts of shipborne barges may be used for towing operations, provided the upper fittings have a specially made end to prevent the rope from being slipped off and meet the requirements of 4.4.2.

5.3.2 The number and arrangement of towing equipment are to be taken proceeding from the structural features, dimensions and general arrangement of the ship.

5.3.3 Towing arrangement of non-self-propelled ships intended for line towing is covered by the requirements of 4.4.2 to 4.4.4 for mooring chocks and bollards, 5.2.5 for tow hooks (if fitted) and 5.2.4.3, 5.2.4.4 for tow lines.

The diameter of the cleat base at which the rope is held is to be not less than 8 diameters of the coupling rope.

5.3.4 The towed non-self-propelled ships are to be supplied with tow lines in accordance with Table 5.3.4 depending on the Equipment Number determined according to 3.2.2.1.

For natural fibre tow lines the value of breaking stress indicated in Table 5.3.4 is to be increased by 20 per cent.

Table 5.3.4

Equipment Number, N_A	Actual breaking strength of the steel wire tow line, in kN
100	49
200	81
300	108
400	133
500	157
600	180
700	204
800	226
900	245
1000	263
1100	277
1200	290
1300	299
1400	308
1500	316
1600	322
1700	327
1800	331
1900	335
2000	338
Note. For intermediate values of the Equipment Number the value of the breaking strength is determined by linear interpolation.	

5.3.5 The breaking strength F_{br}, in kN, of the tow line necessary to determine the towing arrangement items is to be not less than that determined by the following formula:

$$F_{br} = n(0{,}25N_A + 35) \quad (5.3.5)$$

where n = number of barges towed line ahead;
N_A = Equipment Number according to 3.2.2.1.

5.4 DEVICES FOR COUPLING PUSHED BARGES ONE TO ANOTHER, TO PUSHERS AND TO CARGO PUSH SHIPS

5.4.1 General.

5.4.1.1 The present requirements apply to the end coupling devices with longitudinal flexible links and longitudinal rigid connections.

Coupling devices of ships connected one to another within the train by active hinges, side couplers and other devices not mentioned above are subject to special consideration by the Register.

5.4.1.2 Any coupling device is to ensure rigid connection of ships within the train and prevent under prescribed service conditions the displacement of ships relative each other in such a way that this group of ships can be regarded as one "shipping unit".

Where convoys consist of a pusher ship and a single pushed ship, the coupling devices may permit controlled articulation.

5.4.1.3 Pushers, cargo push ships and barges within the towed train ahead of which other barges are located are to have a coupling device the width of which is to be not less than 2/3 of the extreme breadth of the ship in the fore part.

Pushed barges are to have a coupling device the width of which is to be not less than 2/3 of the extreme breadth of the ship in the aft part.

5.4.1.4 A possibility is to be provided for coupling the ship with both loaded and empty barges.

5.4.1.5 The coupling device components are not to extend beyond the overall breadth of the ship.

5.4.1.6 Handling of coupling devices and their components is to be easy and safe so that the ships can be fast coupled without imposing hazards upon the operating personnel.

Ships are to be coupled in such a way as to ensure easy and safe passage of the operating personnel from one ship to another.

5.4.1.7 The coupling device and its connecting components are to withstand the action of forces arising in operation within the intended navigation area for which the ship is intended and transmit them to the strength members of the ship's hull.

5.4.1.8 A sufficient number of coupling units is to be provided.

5.4.2 Coupling forces and scantlings of the coupling device components.

5.4.2.1 Scantlings of the longitudinal flexible members of coupling devices specified in 5.4.1.1, for ships trains and groups are to be calculated with consideration for the sufficient safety margin and the coupling forces involved, in kN (refer to Fig. 5.4.2), determined by the following formulae:

.1 the coupling unit is located between the pusher and the barges or other ships

$$F_{SB} = C_P P_B (L_S/B_S) 10^{-3}; \quad (5.4.2.1\text{-}1)$$

.2 the coupling unit is located between the cargo push ship and the pushed ship

$$F_{SF} = C_{PB} P_B (L_S/H_k) 10^{-3}; \quad (5.4.2.1\text{-}2)$$

.3 the coupling unit is located between the pushed ships

$$F_{SL} = C_{PB} P_B (L'_S/H'_k) 10^{-3} \quad (5.4.2.1\text{-}3)$$

where F_{SB}, F_{SF}, F_{SL} = coupling force of the longitudinal member;
C_P = 130 to 270, is an empirical coefficient determined on agreement with the Register depending on the area of navigation and service conditions;
C_{PB} = 60 to 80, is an empirical coefficient determined on agreement with the Register depending on the area of navigation and service conditions;
P_B = power of propulsion plants, in kW;
L_S = distance between the pusher stern and the coupling unit, in m;
L'_S = distance between the pusher stern and the coupling unit located between the first pushed ship and coupled ships situated directly ahead of it;
H_K, H'_k = lever arm of the longitudinal member, in m;
B_S = breadth of the pusher, in m.

5.4.2.2 The coupling force calculated by the Formula (5.4.2.1-3) is used as a basis for determination of

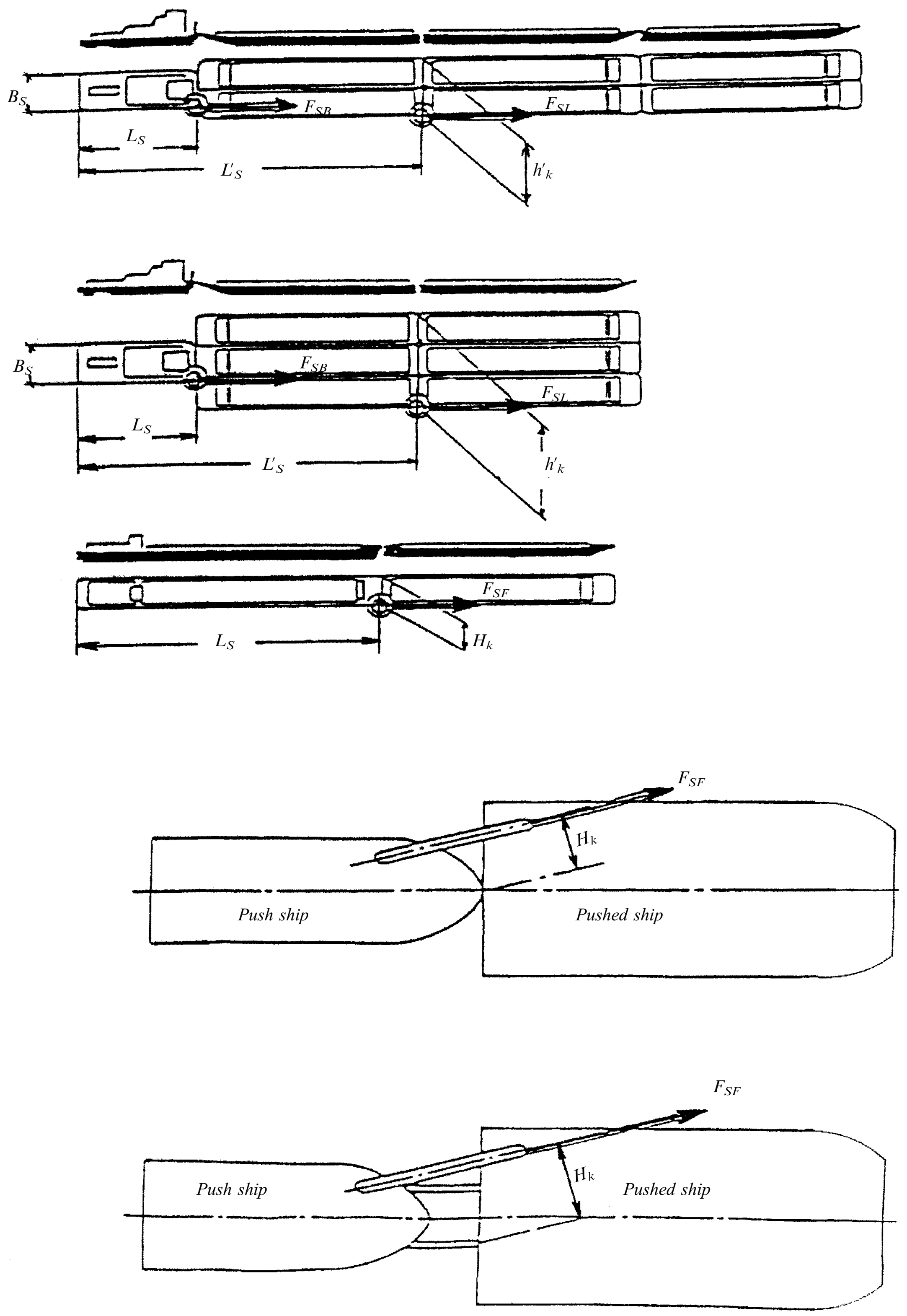

B_S
F_SB
F_SL
L_S
L'_S
h'_k
B_S
F_SB
F_SL
L_S
L'_S
h'_k
F_SF
L_S
H_k
F_SF
Hk
Push ship
Pushed ship
F_SF
Hk
Push ship
Pushed ship

Fig. 5.4.2

scantlings of the other longitudinal members in coupling units between the pushed ships.

5.4.2.3 For longitudinal coupling of individual ships at least two coupling units are to be provided.

The scantlings of each coupling unit are to be such that the unit can withstand the coupling forces calculated by the Formulae (5.4.2.1-1), (5.4.2.1-2) and (5.4.2.1-3).

Where a rigid connection is used, only one coupling unit may be used provided it ensures efficient connection between the ships.

5.4.2.4 The force in each rope used for coupling ships is to be determined basing on the design rope pattern in the coupling arrangement.

Not more than three turns of each rope used are to be placed on bollards or similar equipment and the rope is to be capable of being taken in at various modes of the intended use.

5.4.2.5 Where a pusher intended for pushing several barges is used, in the train with one pushed barge the design coupling force is to be determined by the Formula (5.4.2.1-2).

5.4.2.6 Mooring bollards and other similar equipment may be used for coupling ships, provided they withstand the coupling forces which can affect them and their number is sufficient for unimpeded performance of normal mooring operations.

5.4.2.7 If pushed barges are intended, in addition to episodic, also to regular line towing, their towing arrangement is to meet the requirements of 5.3.

5.4.3 Special requirements for coupling devices for bendable trains.

5.4.3.1 The coupling device for bendable trains is to ensure rigid connection of ships. Check to verify whether the minimum requirements for navigational characteristics and manoeuvrability of the pushed train are complied with is made by means of test with the use of a rigid connection.

5.4.3.2 The coupling device for bendable trains is to be fitted with a drive providing flexible connection. That drive is to also enable the train to return safely from the bend position to the initial one.

5.4.3.3 Where a power drive (including hydraulic or electric) is used in the coupling device, provision is to be made for an independent second drive or a power source.

5.4.3.4 If the main drive is a hydraulic drive and the second drive is a hand-operated hydraulic drive each drive is to operate independently of one another.

Where the main and the second drives are hydraulic drives a pump with an independent power source is to be provided for each of them.

Piping, valves, controls, etc. of each drive are to be, as a rule, independent. However, these two drives may have common structural components, for example, cylinder block.

5.4.3.5 If the main and the second drives are electric drives, their power supply and control circuits are to be independent. Each of these drives is to have its own electric motor.

5.4.3.6 If the electric motor or the pump of the second drive of the coupling device is powered by an auxiliary generating unit and where in order to bring it to the operating mode more than 5 s are required, the operation of the second electric motor or the second pump during the time period when it is brought to the operating mode is to be maintained by a buffer unit.

5.4.3.7 The possibility is to be provided to exercise control over the coupling device for bendable trains and to operate it from the wheelhouse at least to perform bending/straightening operation.

Visual alarm is to be provided on control desks to indicate the operation of the coupling device drive and to make it possible to identify what drive is actuated.

In case of an accidental disconnection or failure of the power drive visual and sound signals are to be transmitted to the control station.

5.5 TOWING ARRANGEMENTS ON SELF-PROPELLED SHIPS

5.5.1 If a self-propelled ship is provided with an arrangement for regular towing of other ship such arrangement is to meet the requirements of 5.2. Self-propelled ships provided with arrangements for regular towing of other ships are to be provided with a tow line having length of at least 100 m and breaking strength, in kN, not lower than 1/4 of the total power, in kW, of the ship's power plant. For the rest the arrangement for regular towing is to comply with the requirements of 5.2.

5.5.2 Ships to be used for auxiliary towing of other ships may be provided with bollards only.

5.5.3 The equipment of self-propelled ships with a simplified towing arrangement intended for the cases of emergency towing is to be agreed upon with the Register.

6 WHEELHOUSE VERTICAL MOVEMENT ARRANGEMENT

6.1 GENERAL

6.1.1 The wheelhouse movable vertically is to ensure effective operation of ships.

6.1.2 The wheelhouse movable vertically and the arrangement for hoisting it are to be so designed as to ensure proper safety of people on board the ship.

6.1.3 Hoisting and lowering are not to hinder the operations performed from the wheelhouse.

6.2 REQUIREMENTS FOR THE ARRANGEMENT DESIGN

6.2.1 The hoisting mechanism of the arrangement is to be designed for hoisting load equal, at least, to 1,5 times the mass of fully equipped wheelhouse with full number of the operating personnel.

6.2.2 The hoisting mechanism of the wheelhouse is to function reliably and without seizing in all possible cases of asymmetric load as well as under all heel and trim angles which are likely to occur during the normal operation of the ship.

6.2.3 Provision is to be made for visual signalling to show the lower and upper end position of the wheelhouse.

6.2.4 All lowering operations are to automatically trigger an audible warning signal.

That requirement is not to apply, if the risk of corporal injury which may result from lowering is prevented by appropriate design features.

6.3 REQUIREMENTS FOR THE MOVEMENT ARRANGEMENT DRIVE

6.3.1 The arrangement for hoisting and lowering the wheelhouse is to be provided with power drive capable of operating under all service conditions of the ship.

6.3.2 The wheelhouse is to be provided with a device for emergency lowering which operates independently of the power drive.

The emergency lowering is to be effected by gravity, be smooth and controlled.

6.3.3 On board ships intended for **Zones 1** and **2** the hoisting mechanism is to provide for the possibility to stop and fix the wheelhouse in different positions. It is to be possible to leave the wheelhouse safely, whatever its position.

A possibility for immediate release of the fixing arrangements is to be ensured under all operational conditions, inclusive of a total power failure.

6.3.4 In end positions the hoisting mechanism is to be automatically disengaged.

6.3.5 Lowering of the wheelhouse under all conditions is to be carried out by one person.

Emergency lowering control is to be possible from both inside the wheelhouse and a control station outside.

The speed of emergency lowering of the wheelhouse is not to be less than the speed of lowering by means of the main drive.

6.3.6 The use of a self-braking device in the hoisting mechanism is not allowed.

7 CARGO HANDLING GEAR

7.1 GENERAL

7.1.1 Cargo handling gear of inland navigation ships is to comply with the requirements of Rules for the Cargo Handling Gear of Sea-Going Ships.

8 LIFE-SAVING APPLIANCES

8.1 GENERAL

8.1.1 The requirements of the present Section apply to life-saving appliances and launching appliances of inland navigation ships being under the Register technical supervision.

8.1.2 Life-saving appliances and launching appliances, as well as the items of equipment and outfit of life-saving appliances and arrangements are to be reliable in operation in the range of environmental temperatures from – 30 to +50 °C and made of suitable material and be resistant to oil and oil products.

8.1.3 Collective life-saving appliances are to:

.1 bear an indication of the use and the number of persons for which they are approved;

.2 have and maintain a stable trim if grabbed by the indicated number of persons for which they are approved;

.3 be rapidly and safely launchable from their place of storage by a single person.

8.1.4 Inflatable life-saving appliances are to be used in accordance with the manufacturer's instructions.

8.1.5 The places of the life-saving appliances storage, their launching devices and the water surface within the launching area are to have sufficient lighting.

8.1.6 Besides the requirements specified in the present Part, life-saving appliances are to comply with the requirements of 6.1.1, Part II "Life-Saving Appliances" of Rules for the Equipment of Sea-Going Ships.

8.1.7 For all persons on board a passenger ship, there are to be muster areas available which satisfy the following requirements:

.1 they are to be in the vicinity of, and permit ready access for all passengers to, embarkation areas unless in the same location;

.2 the total area of the muster areas, A_S, in m^2, is to correspond to at least the value produced by the following formulae:

day-trip ships:

$$A_S = 0{,}35F_{\max}; \qquad (8.1.7.2\text{-}1)$$

cabin ships:

$$A_S = 0{,}45F_{\max} \qquad (8.1.7.2\text{-}2)$$

where $F_{\max}$ = maximum permitted number of passengers on board;

.3 each individual muster area is to be larger than 10 m^2;

.4 the muster areas are to lie above the margin line;

.5 life-saving appliances on each side of the ship are to be safely accessible from the muster and evacuation areas;

.6 the muster and evacuation areas are to be shown as such in the safety plan and signposted on board the ship;

.7 if movable furniture is located in a room in which muster areas are defined, it is to be secured appropriately to avoid slipping;

.8 if fixed seats or benches are located in a room in which muster areas are defined the corresponding number of persons need not be taken into account when calculating the total area of muster areas according to 8.1.7.2. However, the number of persons for whom fixed seats or benches in a certain room are taken into account is not to exceed the number of persons for whom muster areas are available in this rom;

.9 the provisions of 8.1.7.7 and 8.1.7.8 are also to apply to free decks on which muster areas are defined;

.10 if collective life-saving appliances are available on board, the number of persons for whom such appliances are available may be disregarded when calculating the total surface area of the muster areas referred to in 8.1.7.2;

.11 in all cases where reductions according to 8.1.7.8 to 8.1.7.10 are applied, the total area of muster areas according to 8.1.7.2 is to be sufficient for at least 50 per cent of the maximum permitted number of passengers.

8.2 EQUIPMENT OF SHIPS WITH LIFE-SAVING APPLIANCES

8.2.1 Self-propelled and non-self-propelled ships in Zone 1.

8.2.1.1 Self-propelled ships in **Zone 1** are to have:

.1 either on each side of the ship, one or more lifeboats of sufficient aggregate capacity to accommodate all persons on board; or

one or more lifeboats capable of being launched on either side of the ship and of sufficient aggregate capacity to accommodate all persons on board; or

ship's boat and, on each side of the ship, one or more liferafts of sufficient aggregate capacity to accommodate all persons on board;

.2 one or more liferafts of sufficient aggregate capacity to accommodate half the total number of persons on board;

.3 a sufficient number of lifejackets for all persons on board;

.4 at least four lifebuoys.

8.2.1.2 On agreement with the Register self-propelled ships need not be equipped with liferafts provided that they are equipped with lifeboats on each side of the ship according to 8.2.1.1.1.

8.2.1.3 In addition to the life jackets specified in 8.2.1.1.3, passenger ships are to be supplied with additional life jackets for watch-keeping personnel and operating personnel responsible for undertaking duties according to the safety rota, as well as for children in quantity equal to 10 per cent of the total number of passengers.

8.2.1.4 In addition to the lifebuoys specified in 8.2.1.1.4, all parts of the deck intended for passengers and not enclosed are to be equipped with two lifebuoys on both sides of the ship, positioned not more than 20 m apart.

8.2.1.5 Passenger ships are to be provided with special life-saving appliances for safe disembarkation of persons in shallow water, to the bank or to another ship.

8.2.1.6 On agreement with the Register for ships with two-compartment status or one-compartment status and having double skins, the aggregate capacity of collective life-saving appliances referred to in 8.2.1.1 may be reduced.

8.2.1.7 Manned non-self-propelled cargo ships and non-self-propelled floating equipment are to be provided with life-saving appliances in accordance with 8.2.1.1 and 8.2.1.2.

Unmanned ships may not be equipped with life-saving appliances.

8.2.2 Self-propelled ships in Zone 2 to 4.

8.2.2.1 Equipment of supply to self-propelled passenger ships with personal life-saving appliances is to be according to Table 8.2.2.1-1.

Table 8.2.2.1-1

Type of ship	Ship's length, in m	Number of persons provided with life-saving appliances	Life-buoys[1]	Lifejackets
Passenger ships and ferries	below 35 35 to 50	below 300 301 – 600	4 6	For 100 per cent of the total number of persons on board the ship + 10 per cent for children. This number may be reduced by 50 per cent where one-compartment flooding standard is ensured
	over 50	601 – 900 901 – 1200 over 1200	8 10 12	

Notes : 1.The number of lifebuoys is to be taken equal to the greater of values determined depending on the ship's length or the number of persons on board the ship.
2. Pushers and tugs are to be supplied additionally with one lifebuoy. On berth-connected ships used as floating hotels, provision is to be made for at least one lifebuoy near each entrance and on each awning deck.
3. For berth-connected ships this requirement applies only to the crew engaged in transit of the ship.

Equipment of other types of ships with personal life-saving appliances and survival craft is to be according to Table 8.2.2.1-2.

8.2.2.2 Passenger ships and ferries of less than 25 m in length, in addition to life-saving appliances specified in 8.2.2.1, are to carry survival craft of an aggregate

Table 8.2.2.1-2

Type of ship	Ship's length, in m	Life-buoys[2]	Lifejackets[3]	Survival craft
Cargo ships, pushers industrial ships, cargo ferries	75 and below	2	For 100 per cent of the total number of persons on board the ship	For 25 per cent of the total number of persons on board the ship, but not less than one lifeboat. If the crew consists of three persons and less, no lifeboat is required.
	over 75	3		

Notes : 1.The number of lifebuoys is to be taken equal to the greater of values determined depending on the ship's length or the number of persons on board the ship.
2. Pushers and tugs are to be supplied additionally with one lifebuoy. On berth-connected ships used as floating hotels, provision is to be made for at least one lifebuoy near each entrance and on each awning deck.
3. For berth-connected ships this requirement applies only to the crew engaged in transit of the ship.

capacity sufficient to accommodate 25 per cent of the total number of persons on board the ship, but not less than one liferaft.

8.2.2.3 Passenger ships and ferries of more than 25 m in length, in addition to life-saving appliances specified in 8.2.2.1, are to carry survival craft of an aggregate capacity sufficient to accommodate 25 per cent of the total number of persons on board the ship, but not less than one lifeboat.

8.2.2.4 The survival craft referred to in 8.2.2.1 to 8.2.2.3 mean lifeboats, ship's boats, liferafts (rigid and inflatable) and life-saving buoyancy aids.

Light-weight rafts, benches, tables and other buoyancy aids designed to support persons on the water surface and meeting the requirements of 8.4.3 may be used as life-saving buoyancy aids.

Depending on of the ship's service conditions and on agreement with the Register rigid and inflated work boats may be used.

8.2.2.5 On agreement with the Register, ships of all types, including passenger ships, may carry only lifebuoys according to 8.2.2.1 where operating in the daytime on a fairway with a depth not exceeding the ship's depth (including superstructure) but not more than 1,8 m, or on a fairway where the distance to the land in any location does not exceed 250 m.

The fairway width may be increased to 500 m, if the possibility of collision with other ships of more then 15 m in length (e.g. due to scheduled ships traffic or if ships are operated by one company, etc.) is completely excluded or highly improbable on such fairway.

8.2.2.6 On agreement with the Register for passenger ships with two-compartment status or one-compartment status and having double skins, the aggregate capacity of collective life-saving appliances referred to in 8.2.2.2 and in 8.2.2.3 may be reduced.

8.2.3 Non-self-propelled ships in Zone 2 to 4.

8.2.3.1 Non-self-propelled cargo ships and non-self-propelled industrial ships are to be supplied with life-saving appliances as self-propelled cargo ships and industrial ships if they are operated with permanent crew.

Unmanned ships may not carry life-saving appliances.

8.2.3.2 Non-self-propelled ferries are to be supplied with life-saving appliances as passenger ships.

Where watertight integrity of non-self-propelled ferries is ensured under full load and with one compartment being flooded the ferries may be supplied only with lifebuoys according to Table 8.2.2.1-1.

8.2.4 Berth-connected ships.

8.2.4.1 The berth-connected ships which are in operation near the shore (platform jetties, guard ships, mooring pontoons, etc.) under 30 m in length are to be provided with two lifebuoys on each deck, and berth-connected ships of more than 30 m in length — with four lifebuoys on each deck.

8.2.4.2 The berth-connected ships which are in operation on a roadstead are to be provided with life-saving appliances as non-self-propelled ships referred to in 8.2.3.1.

8.3 STOWAGE OF LIFE-SAVING APPLIANCES ON BOARD THE SHIP

8.3.1 General.

All survival craft, as far as possible, are to be evenly distributed on both sides of the ship. All collective life-saving appliances are to be so stowed that they can be launched as quickly as possible.

8.3.2 Stowage of life-saving buoyancy aids.

8.3.2.1 Life-saving buoyancy aids are to be stowed on open decks in readily accessible positions. Securing devices of life-saving buoyancy aids are to be so designed as to ensure their free-floating after water entry.

8.3.2.2 Rafts may be placed one on the top of another provided that they are so secured as to preclude shifting in a seaway.

8.3.3 Stowage of lifebuoys and lifejackets.

8.3.3.1 Lifebuoys are to be evenly distributed on both sides of the ship in readily accessible positions. Securing of lifebuoys which does not ensure their free floating when the ship sinks is not allowed. At least one lifebuoy is to be in the immediate vicinity of the wheelhouse and is to be equipped with a self-igniting light.

8.3.3.2 Lifejackets are to be stowed in readily accessible positions. At least, 20 lifejackets are to be stowed in one place.

Clear symbols or an inscription "Lifejackets" are to be provided in the places where lifejackets are stowed.

8.4 REQUIREMENTS FOR LIFE-SAVING APPLIANCES AND LAUNCHING APPLIANCES

8.4.1 General.

The materials used for manufacturing of life-saving appliances and launching appliances are to comply with the requirements of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

Hull structure and strength of glass-reinforced plastic lifeboats are to comply with the requirements of Part XVI "Hull Structure and Strength of Glass-Reinforced Plastic Ships and Boats" of Rules for the Classification and Construction of Sea-Going Ships.

8.4.2 Lifeboats and ship's boats.

8.4.2.1 Lifeboats are to be not less than 4 m in length for ships in **Zone 2** and not less than 3,5 m in length for ships in **Zones 3** and **4**. All lifeboats are to be well designed and of such shape and proportions that they have ample stability and sufficient freeboard when carrying their full load of persons and equipment.

8.4.2.2 All lifeboats are to be of sufficient strength to enable them to be safely hoisted out when loaded with their full complement of persons and equipment.

Each lifeboat to be launched by falls is to have no residual deflection on removal of the full load increased by 25 per cent.

8.4.2.3 The lifeboat with its full complement of persons and equipment, when flooded to the top of gunwale is to maintain sufficient buoyancy and stability.

8.4.2.4 The lifeboat's buoyancy is to be ensured by watertight air cases in the lifeboat's hull or other equivalent non-corrodible buoyant material resistant to oil or oil products affect.

In general, the length of the watertight air cases is to be not more than 600 mm. However, where from structural considerations, air cases of greater size are required, their length may be increased to 1200 mm, with watertight diaphragms and transverse stiffeners being fitted at the same time.

8.4.2.5 To ensure lifeboat's damage stability, mentioned in 8.4.2.3, air cases are to be fitted along the sides. If compliance with this requirement is impossible, air cases may be installed in fore part, aft part of the lifeboat or amidships under the thwarts.

Buoyancy means are not to be installed in the bottom part of the lifeboat.

Buoyancy means are to be so arranged as to prevent possible damage thereof, to ensure easy replacement and to preclude their shifting.

8.4.2.6 All lifeboats are to be equipped with seats sufficient for at least three persons.

8.4.2.7 The lifeboat's stability is to be sufficient when loaded with the maximum allowed number of persons. Stability is considered to be sufficient if a freeboard of not less than 100 mm remains when 50 per cent of the maximum allowed number of persons are seated on one side of the lifeboat.

8.4.2.8 The number of persons whom the lifeboat is permitted to carry is determined by gross volume established by the recognized methods as not less than 0,225 m^3 per person. The width of the seat is to be taken not less than 450 mm per person.

The final carrying capacity of the lifeboat is to be established by seating space test for adults who wearing lifejackets can be seated without interfering with the rowing and operation of the lifeboat.

8.4.2.9 Lifeboats are to be equipped in accordance with Table 8.4.2.9.

Table 8.4.2.9

Nos	Items of the lifeboat's equipment	Unit	Number
1	Oars	Set	1[1]
2	Thole pins or crutches with a lanyard	Set	1[1]
3	Boat-hook of length equal to the length of oar	Pcs	1
4	Rudder with accessories and rudder pennant	Pcs	1[2] 1
5	Bailer	Pcs	1
6	Rope or chain painter of 15 m long	Pcs	
7	Covers for lifeboats stowed on board the ship	Pcs	1
8	Lifelines on the boat sides with floats at each sag (in the form of a noose) or buoyant lifelines with sags	Pcs	1[3]
9	Plugs for drainage holes with lanyards	Pcs	2
10	Electric torch	Pcs	1
11	Fire-extinguisher[4]	Pcs	1
12	First-aid outfit in a waterproof case	Pcs	1

Notes: 1. Composition of the set (number of rowing and steering oars) is established depending on the lifeboat type.
2.The necessity of the rudder is determined by the lifeboat type.
3. Only for lifeboats with the freeboard of not more than 0,7 m.
4. Required only for motor lifeboats.

8.4.2.10 All items of the lifeboat's equipment, except the boat-hook are to be secured in their normal positions.

8.4.2.11 The surface of the sheer strake over the width of 150 mm and that of the gunwale is to be painted in saturated orange colour.

8.4.2.12 On the sheer strake of the lifeboat on each side of the lifeboat's bow in clear permanent characters or equivalent are to be marked:

.1 the name and the port of registry of the ship to which the lifeboat belongs;

.2 the number of persons for which the lifeboat is approved.

8.4.2.13 The engine-powered lifeboat is to be fitted with an internal combustion engine provided with a reverse-reduction gear or other device to ensure astern running.

8.4.2.14 The engine of the lifeboat is to be manually started within 2 min under any conditions likely to be encountered in operation of the ship. The force on the handle when actuating the propelling gear at the moment of starting is not to be more than 160 kN per person.

Additional devices and arrangements are allowed to be used to facilitate starting of the engine.

8.4.2.15 The engine power is to be such as to ensure speed of the lifeboat loaded with its full complement of persons and equipment not less than 11 km/h and not more than 15 km/h when proceeding ahead in calm water.

Fuel oil capacity is to be sufficient to ensure operation of the engine for a period of not less than two hours in the running mode. To store fuel oil, the lifeboat is to be provided with permanent tanks for the stationary engine or with portable tanks for outboard engine.

8.4.2.16 The engine and associated equipment are to be so protected as to ensure uninterrupted operation of the engine when the lifeboat is flooded to the crankshaft axis.

8.4.2.17 Beds for the engine and reverse-reduction gear are to be sufficiently strong and resistant to vibration.

8.4.2.18 The engine-powered lifeboat is to carry instruction for starting the engine.

8.4.2.19 On either side of the engine-powered lifeboat means are to be fitted for towing liferafts.

8.4.2.20 In addition to the equipment according to 8.4.2.9, every lifeboat is to carry a white light visible all round the horizon for 360°. The principal characteristics of this light and its position in the lifeboat are to meet the requirements of European Inland Navigation Rules or Main Regulations for the Danube Navigation.

8.4.2.21 Ship's boats are to meet the following requirements:

.1 they are to be easy to steer and manoeuvre, they are to maintain their course and not drift significantly under the effect of the wind, the current or the waves;

.2 they are to have seats according to 8.4.2.6;

.3 they are to be sufficiently resistant;

.4 their volume is to be at least 1,5 m^3, or the product of $L_C B_C H_C$ is to represent 2,7 m^3, where L_C is the ship's boat length, in m, B_C is the ship's boat breadth, in m, and H_C is the ship's boat depth, in m;

.5 their freeboard is to be at least 250 mm with three persons of approximately 75 kg each on board;

.6 they are to be adequately stable. This is to be considered adequate if there is a residual freeboard of at least 100 mm when two persons of roughly 75 kg each are on one side as close as possible to the gunwale;

.7 their buoyancy Q, in N, with no passengers on board, but completely filled with water, is to be at least equal to

$$Q = 300(L_C B_C H_C) \qquad (8.4.2.21.7)$$

where L_C, B_C, H_C = refer to 8.4.2.21.4;

.8 it is to be possible for one person to launch such ship's boats safely. If a power-driven unit is used for launching it is to be ensured that a failure of the power supply will not jeopardize rapid and safe launching;

.9 the following gear is to be on board:

one set of oars;

one mooring rope;

one bailer;

.10 they are to be equipped with an engine and a searchlight if they are used on passenger ships.

8.4.2.22 Inflatable ship's boats are to be permitted provided:

.1 they comply with the requirements of 8.4.2.21;

.2 they have several compartments (at least two) in the buoyancy chamber;

.3 are permanently operational.

8.4.2.23 If a ship's boat is used as a lifeboat it is to comply with the requirements of 8.1, 8.2.1, 8.4.2, as well as 8.4.2.22 and 8.4.2.23.

Besides, ship's boats used as lifeboats are to comply with the following requirements:

.1 seat width is to be at least 450 mm per person, while the maximum permissible number of persons is not to exceed the value determined by the formula

$$n = 3(L_C B_C H_C), \qquad (8.4.2.23.1)$$

where L_C, B_C, H_C = refer to 8.4.2.21.4;

.2 their stability is to be considered adequate in accordance with 8.4.2.7;

.3 they are to be fitted with a line securely fastened round the outside perimeter enabling them to be grabbed by persons being in water.

8.4.2.24 An inflatable ship's boat may be used as a lifeboat if it complies with the requirements of 8.4.2.23 and also if provided it:

.1 has and maintains a stable trim with the number of persons permitted, even with only half of the air compartments inflated;

.2 inflates automatically or by manual command when launched.

8.4.3 Life-saving buoyancy aids, liferafts, lifebuoys and lifejackets.

8.4.3.1 The buoyancy of a life-saving buoyancy aid is to be sufficient to support the design number of persons in the water and holding on the life-saving buoyancy aid.

8.4.3.2 The number of persons n, supported by the life-saving buoyancy aid is to be taken basing on the least value determined by the following formulae:

$$n = P_n/0{,}3; \qquad (8.4.3.2\text{-}1)$$

$$n = Q/142 \qquad (8.4.3.2\text{-}2)$$

where P_n = perimeter of the life-saving buoyancy aid, in m;
0,3 = allowable length for one person in the perimeter of the life-saving buoyancy aid, in m;
Q = buoyancy of the life-saving buoyancy aid, in N;
142 is the buoyancy of the life-saving buoyancy aid per person, in N.

8.4.3.3 The strength of the life-saving buoyancy aid is to be such that when it is dropped into the water from a height of 18 m, the life-saving buoyancy aid will sustain no damages affecting its operation.

8.4.3.4 The life-saving buoyancy aid is to be stable when floating either way up.

8.4.3.5 The buoyancy of the life-saving buoyancy aid is to be ensured by air cases or equivalent buoyancy.

A life-saving buoyancy aid is to be capable of supporting an iron load of 7,5 kg in fresh water for 24 hours.

8.4.3.6 The life-saving buoyancy aid is to have a life-line securely becketed round the outside or a life-line fitted with floats with sags the number of which is to correspond to the number of persons supported by the life-saving buoyancy aid.

8.4.3.7 The life-saving buoyancy aid is to be painted in saturated orange colour. The life-saving buoyancy aid is to be marked in conspicuous position with inscription "Life-Saving Buoyancy Aid", design number of persons and the name of the ship.

A life-saving buoyancy aid is to have permanently fixed fluorescent surfaces measuring at least 100 cm^2.

8.4.3.8 Every life-saving buoyancy aid is to be fitted with a painter of not less than 18 m in length and not less than 8 mm in diameter. The painter is to be secured to the life-saving buoyancy aid in such a way that the life-saving buoyancy aid can be towed. The life-saving buoyancy aid is to be fitted with a device to secure the painter of another life-saving buoyancy aid.

8.4.3.9 Each lifebuoy is to be fitted with a buoyant lifeline which is not less than 30 m long and 8 to 11 mm in diameter.

If the ship travels at night half of the lifebuoys are to be equipped with self-igniting lights. The lifebuoys equipped with self-igniting lights are not to be equipped with lifelines.

8.4.3.10 The capacity of liferafts is to be not less than 4, but not more than 20 persons, and they are to provide buoyancy of at least 750 N per person in fresh water.

8.4.3.11 Liferafts, lifebuoys and lifejackets are to meet the relevant requirements of Section 6, Part II "Life-Saving Appliances" of Rules for the Equipment of Sea-Going Ships except those especially stated in the present Part.

Deviations from these requirements are subject to special consideration by the Register.

8.4.4 Launching appliances.

8.4.4.1 Davits are to be provided to lower and recover lifeboats.

Where compliance with this requirement is impossible, other equivalent devices or towing of the boat behind the ship may be allowed on agreement with the Register.

8.4.4.2 Davits, falls, blocks and all other gear are to be of sufficient strength for the safe hoisting out with the full complement of persons and equipment.

Besides, when calculating strength of the boat handling gear components a heel of at least 10°C is to be taken into consideration.

The davit falls are to be long enough to enable the boat to reach the water with the light ship heeled to at least 10° either way. Not less than three turns of wire are to remain on the winch drum in this case.

8.4.4.3 Power-operated boat winches as well as boat winches driven by other deck machinery are to be provided with an efficient hand gear.

8.4.4.4 Scantlings of structural members of launching appliances are to be selected in such a way that under the working load a safety factor not less than that given in Table 8.4.4.4 is ensured.

Table 8.4.4.4

Nos	Item of the launching appliance	Minimum safety factor	
		Value	Relative to
1	Structural members including beds	2,5	yield stress
2	Blocks, shackles, swivels, etc	5	breaking stress
3	Chain links	4	breaking load
4	Steel wire	5	actual breaking load of the steel wire
5	Natural or synthetic fibre ropes[1]	7	actual breaking load of the rope

Note. Synthetic fibre ropes are to be used on agreement with the Register.

8.4.4.5 The time required for launching the boat is not to exceed 5 min, including the time required to prepare the boat for launching out and turning out the boat. The said time does not include the time required for boarding the lifeboat.

8.5 EQUIPMENT OF SHIPS WITH SHIP'S BOATS

8.5.1 The following ships are to carry ship's boats complying with the requirements of 8.4.2.21 and 8.4.2.22:

.1 self-propelled and manned towed non-self-propelled cargo ships of more than 150 t deadweight;

.2 tugs and push-tugs with a water displacement of more than 150 m^3;

.3 floating equipment (floating cranes, dredgers, etc.);

.4 passenger ships.

8.5.2 The Register may waive the application of the rule of providing the ship with ship's boats in the case of passenger ships intended to carry a maximum number of 250 passengers and with a length of not more than 25 m, provided that they are equipped with a suitable installation (mobile installations are allowed) to enable persons to be recovered safely from the water. Such installation is to be subject to the following conditions:

.1 one person alone is to be able to operate the installation;

.2 access to the installation is to be provided from both sides of the ship;

.3 the installations is to be outside the danger area of the of the propulsion systems;

.4 effective communication is to be possible between the boatmaster and the person in charge of the installation.

8.5.3 The Register may waive the application of the rule of providing the ship with ship's boats in the case of passenger ships certificated to carry a maximum number of 600 passengers and with a length of not more than 45 m, provided that the passenger ship is equipped with a suitable installation as in 8.5.2 and the ship has:

.1 a rudder propeller, a cycloidal propeller or a water jet as main propulsion; or

.2 a main propulsion system with two propulsion units; or

.3 a main propulsion system and a bow thruster.

8.6 EQUIPMENT OF HIGH-SPEED CRAFT WITH LIFE-SAVING APPLIANCES

8.6.1 High-speed craft are to be provided with lifebuoys and lifejackets in accordance with 3.2 to 3.6, Part XVI "Life-Saving Appliances" of Rules for the Classification and Construction of High-Speed Craft.

8.6 SAFETY ROTA AND INSTRUCTIONS IN EMERGENCY CASES

8.7.1 A safety rota is to be provided on board passenger ships describing the duties of the crew and the shipboard personnel depending on the posts they occupy in such eventualities as evacuation of passengers in emergencies or a person overboard.

8.7.2 The safety rota includes a safety plan in which at least the following are clearly and precisely designated:

.1 areas intended for use by persons with reduced mobility;

.2 escape routes, emergency exits and muster and evacuation areas;

.3 collective life-saving appliances and ship's boats;

.4 individual life-saving appliances;

.5 first-aid kits.

8.7.3 On passenger high-speed craft, in public spaces, as well as in prominent positions at the muster areas and near each passenger seat, details are to be posted showing the instructions in emergency cases including the following:

.1 muster areas;

.2 escape routes;

.3 what to do;
.4 life-saving appliances location;
.5 how to put on a lifejacket.

8.7.4 In each mess room, lounge and crew recreation area there are to be an instruction on abandoning the ship.

9 OPENINGS IN HULL, SUPERSTRUCTURES AND DECKHOUSES AND THEIR CLOSING APPLIANCES

9.1 GENERAL

9.1.1 The requirements of the present Section apply to inland navigation ships including shipborne barges to which a minimum freeboard is assigned in accordance with the requirements of 4.6, Part IV "Stability, Subdivision and Freeboard". Along with that, it is stipulated that shipborne barges (lighters) are carried under the deck of the barge carrier and are operated as facilities sailing on their own only in assigned areas of navigation.

Deviations from these requirements may be allowed for those ships to which a greater than minimum freeboard is assigned on condition that the Register is satisfied with the safety measures taken.

9.1.2 Closing appliances of openings in the hull, superstructures and deckhouses are to comply with the requirements of 2.6.5. Part V "Fire Protection".

9.2 SIDE SCUTTLES, WINDOWS AND FLUSH DECK SCUTTLES

9.2.1 The number of side scuttles in the shell plating below the freeboard deck is to be reduced to a minimum.

Side scuttles may be round and rectangular in shape.

Engine and boiler rooms are not to have side scuttles in the shell plating.

9.2.2 On ships in **Zone 1**, side scuttles in spaces below the freeboard deck, windows in superstructures, deckhouses and companionways on the freeboard deck are to be watertight. In addition, side scuttles in spaces below the freeboard deck are to be provided with permanently attached deadlights.

On ships in **Zones 2** to **4** windows in superstructures, deckhouses and companionways on the freeboard deck may be weathertight.

The distance between the side scuttle in the shell and the maximum draught level is not to be less than 300 mm for ships in **Zone 1** and 100 mm for ships in **Zones 2** to **4**.

9.2.3 Window panes of superstructures and deckhouses are to be manufactured from pre-stressed glass or laminated glass. Glass used for all side scuttles arranged below the freeboard deck is to be hardened and have a thickness not less than 8 mm for inner diameter of 300 mm.

9.2.4 Depending on the navigation area, type and shape of the side scuttle, the requirements which are subject to special consideration by the Register may be relaxed.

9.2.5 Where on ships in **Zone 2** open coaming-free companion hatches leading to spaces situated below the freeboard deck are provided inside superstructures or deckhouses, the widows in the shell plating of the superstructures of the first tier and in the front bulkheads of superstructures or deckhouses are to be of splashproof type and the glass is to be non-splintering of not less than 6 mm in thickness.

9.2.6 To provide natural illumination of spaces situated below the freeboard deck where no side scuttles can be fitted, flash deck scuttles of watertight type manufactured of solid or prism glass mounted in metal frame may be fitted.

9.2.7 On passenger ships watertight windows may be fitted in the side plating below the margin line on condition that they can not be open and are strong enough.

9.3 MANHOLE COVERS, OUTER DOORS, COMPANION HATCHES, SKYLIGHTS AND VENTILATING TRUNKS

9.3.1 Covers of manholes and cofferdams fitted on the freeboard deck are to be made of steel or other material approved by the Register.

The thickness of the covers is not to be less than that of the plating on which they are fitted. The covers are to be efficiently attached to the coaming or doubling ring by means of bolts or pins with nuts.

When secured, the covers are to be tight under inner pressure corresponding to the test pressure of compartment or the tank under consideration. The tightness is to be provided by gaskets resistant to the liquid carried in the tanks.

9.3.2 All outer doors in enclosed superstuctures, deckhouses, companionways and hatch covers fitted on the freeboard deck are to be splashproof on ships in **Zones 2** to **4** and watertight on ships in **Zone 1**.

9.3.3 Height of companionway and skylight coamings of companion hatches, companions and access openings to superstuctures and deckhouses is to be not less 150 mm on ships in **Zones 2** to **4** and at least 300 mm on ships in **Zone 1**.

The height of coamings may be reduced on condition of compliance with the requirements of 4.4.3, Part IV "Stability, Subdivision and Freeboard".

Inner doors in superstructures and deckhouses may have no coamings.

9.3.4 On ships in **Zone 1** and **Zone 2**, the outer doors in superstructures and deckhouses of the first tier are to have as strong a construction as that of the bulkheads in which they are fitted.

9.3.5 On agreement with the Register, depending on the navigation area and purpose of the ship, outer doors may be made of wood or other materials.

9.3.6 External deck openings intended for companion hatches to the ship's spaces located below decks are to be protected by covers made of steel or other material approved by the Register and being permanently attached to coamings.

The thickness of the metal cover plate is to be equal to 0,01 times the spacing of stiffeners, but not less than 3 mm.

9.3.7 Deck openings intended for ventilation and illumination of galleys, machinery, sanitary, etc. spaces are to be protected by strong and watertight skylights and ventilating trunks.

On ships in **Zones 2** to **4** the openings intended for skylights may be provided with splashproof covers in case where the lowest point of these openings is situated at a height exceeding the safety distance according to 4.5.1, Part IV "Stability, Subdivision and Freeboard".

Watertightness and splashproofness is to be provided by rubber or other suitable gaskets.

9.3.8 Glass for windows in the covers of skylights is to be hardened and of at least 6 mm thick if the inner diameter is 450 mm.

For smaller inner diameters, the thickness of glass may be reduced, but not less than to 3 mm.

Glass for windows in the covers of engine room skylights must necessarily be wire-reinforced, its thickness in this case may be 5 mm, and the requirements relating to its hardening are not applicable.

Wire-reinforced glass may be attached to covers of skylights of other spaces.

9.3.9 Glass is to be efficiently attached to the covers by means of frame and have watertight gasket of rubber or other suitable material on its contour.

9.3.10 Covers of skylights and ventilating trunks are to have securing devices. Where the hatches are used also as emergency exits, securing devices are to be capable of being operated from each side of the cover.

9.3.11 Ventilator heads located in exposed parts of the freeboard deck are to have a strong steel coaming the height of which is to be not less than that required for hatch coamings.

Ventilator heads for ships in **Zone 1** are to have watertight closures.

9.3.12 The covers of manholes fitted on the vertical bulkheads of tanks are to be provided with grips to remove them by hand.

9.3.13 The force necessary to lift covers of manholes or companion hatches from below as well as to open doors is not to exceed 160 N.

9.4 HATCH COVERS OF CARGO HOLDS ARRANGED FOR THE CARRIAGE OF LIQUID CARGOES IN BULK

9.4.1 Hatch covers of cargo holds arranged for the carriage of liquid cargoes in bulk are to be watertight.

The tightness is to be provided by a rubber or other suitable gasket resistant to the liquid carried.

9.4.2 Hatch covers of cargo holds are to be made of steel or other material approved by the Register.

9.4.3 The thickness of the steel cover plate is not to be less than the thickness of the deck plating on which the covers are fitted, but not less than 6 mm.

For the covers made of light alloys the thickness of the cover plate is to be increased by 20 per cent.

The cover plate is to be reinforced by stiffeners.

9.4.4 The hatch cover is to be provided with a sighting port having an inner diameter of 150 mm and closed by a cover of similar construction, or with other sighting arrangement approved by the Register.

9.5 HATCH COVERS OF DRY CARGO HOLDS

9.5.1 Exposed cargo hatchways on the freeboard deck are to be fitted with watertight closures on ships in **Zone 1** and sprayproof closures in **Zones 2** to **4**.

The coamings of hatchways are to be not less than 300 mm high on ships in **Zone 1** and 150 mm on ships in **Zones 2** to **4**.

9.5.2 The top plating thickness of steel hatch covers having no intermediate supports and resting only on the hatch-side coamings is not to be less than 3 mm.

Where a long-duration protective anticorrosive coating (e.g. zinc coat) is applied, the design top plating thickness of the cover may be allowed.

9.5.3 The cross-sectional modulus W, in cm^3, in the middle part of the cover is to be not less than that determined by the following formula:

$$W = 1{,}3pbl^2. \qquad (9.5.3\text{-}1)$$

The cross-sectional inertia moment J, in cm^4, of the cover in the middle part is to be not less than that determined by the following formula:

$$J = 1{,}5pbl^3 \qquad (9.5.3\text{-}2)$$

where p = design load on the cover including its own mass, but not less than 1,6 kPa;

b = width of the cover, in m;

l = length of the cover between supports, in m.
In exceptional cases, for example, when the navigation area is restricted, the load p may be reduced on agreement with the Register.

9.5.4 The top plating thickness of hatch covers made of galvanized corrugated plate, having no intermediate supports and resting only on hatch longitudinal coamings is to be not less than 1,5 mm. In other respects, they are to meet the requirements of 9.5.3.

9.5.5 The section modulus W, in cm^3, of hatch covers made of light alloys, having no intermediate supports and resting only on the hatch longitudinal coamings is to be calculated by the Formula (9.5.3-1) considering the factor of increase $k = 1,5$.

The inertia moment J, in cm^4, of these covers is to be not less than that determined by the following formula:

$$J = 4,1pbl^3 \qquad (9.5.5)$$

where for p, b, l = refer to 9.5.3.

9.5.6 The thickness of longitudinal matchboards and transverse connecting boards of wooden covers is to be not less than 30 mm. Transverse boards are to be of 120 mm in width and be spaced 1,5 m apart.

The wood used for hatch covers is to be of good quality, dry, without any defects and putrefactive inclusions and of the type and grade which proved to be satisfactory for this purpose.

9.5.7 Before installation, matchboards and connecting boards are to be impregnated by a preservative which protects them from putrefaction.

9.5.8 Hatch covers are to be secured in such a way as to prevent them from an accidental shifting and lifting by wind, by cargo handling, mooring, towing and other equipment.

9.5.9 Hatch covers of shipborne barges on which containers are carried and which are transported on open decks of barge carriers in positions 1 and 2 according to 7.1.4, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships are to meet the requirement of 7.10 of the said Part.

9.6 OPENINGS IN WATERTIGHT SUBDIVISION BULKHEADS AND THEIR CLOSING APPLIANCES

9.6.1 Unless expressly provided otherwise, the present Chapter covers passenger ships to which the requirements of 3.1.14, Part IV "Stability, Subdivision and Freeboard" apply.

For other ships, the requirements of the present Chapter apply to the bulkheads referred to in 2.7.1, Part II "Hull". For these ships, the requirements of the present Chapter may be relaxed. The degree of relaxation is subject to special consideration by the Register in each case.

9.6.2 The number and dimensions of openings in watertight bulkheads is to be reduced to a minimum compatible with the design and normal service conditions of the ship.

No doors and manholes are allowed in collision bulkhead below the watertight bulkhead deck and in bulkheads separating machinery spaces from passenger spaces and spaces for accommodation and serving of the crew.

9.6.3 Where piping and electric cables are penetrating watertight bulkheads, the requirements of 5.1, Part VII "Systems and Piping" and of 16.8.6.1, Part IX "Electrical Equipment" are to be taken into consideration.

9.6.4 Manholes fitted in watertight bulkheads are to comply with the requirements of 9.3.1.

9.6.5 Doors in watertight bulkheads are to be provided with closing appliance ensuring their watertightness. Doors are to be sliding doors with horizontal or vertical motion. The use of hinged doors is subject to special consideration by the Register.

Doors are to withstand the pressure of water head of the height measured from the lower edge of doorway to the underside of the bulkhead deck plating at the centre line. The width of the door aperture is not to exceed 1,2 m.

9.6.6 Doors in watertight bulkheads which remain open over a long period of time are to be so designed as to provide the possibility of closing and opening the doors locally from both sides of the bulkhead as well as from a readily accessible position above the bulkhead deck.

All doors are to be provided with indicators which make it possible to verify from each control station if the door is open or closed.

It is necessary that after the door has been remotely closed, it can be reliably open and closed from the local control station.

The time necessary for a door closure is not to be less than 30 s and not more than 60 s.

Automatic audible alarm which is to sound whenever the door is closed is to be provided.

The means of operation of the doors as well as alarm systems are to be capable of functioning independently of the dominant ship's mains.

Indicators are to be provided at the control station in the wheelhouse to show whether the doors in watertight bulkheads are open or closed.

9.6.7 Doors (including hinged doors) in watertight bulkheads which are opened and closed by hand and not controlled remotely may be only fitted in places inaccessible for passengers. They are to be closed at all times and be opened only for the time when people pass through the doorway. Fast and efficient securing of doors is to be provided by proper devices, and the force applied to the hand wheel, knob or other gear is not to exceed 160 N.

An inscription "Door is to be immediately closed after each passage" is to be marked on both sides of such doors.

9.6.8 By way of derogation from 9.6.7, passenger ships with a length not exceeding 45 m are allowed to have on board, in the passenger area, a manually controlled bulkhead door without remote control if:

.1 the ship has only one deck;

.2 the door is accessible directly from the deck and is not more than 10 m away from the exit to the deck;

.3 the door coaming height is at least 300 mm and each compartment divided by the door is fitted with a bilge level alarm; on passenger sailing ships in passenger accommodations the coaming height may be reduced to at least 200 mm.

9.6.9 The distance between the shell plating and the doors in bulkheads and the means of operation thereof is to be not less than 1/5 of the ship's breadth; this distance is to be measured at right angles to the centre line of the ship at the level of the deepest draught.

9.6.10 The ship is to carry an instruction requiring that in the event of an emergency all the openings and doors fitted in watertight bulkheads are to be immediately closed.

10 MISCELLANEOUS ARRANGEMENTS AND EQUIPMENT

10.1 GENERAL

10.1.1 The requirements of the present Section apply to the arrangement and equipment of accommodation and service spaces for the crew and passengers, to exits, stairways, passageways, guard rails, equipment of cargo holds, hoisting gear of barges, as well as to providing view from the wheelhouse.

10.2 LOCATION OF ACCOMMODATION, SERVICE AND PUBLIC SPACES

10.2.1 No accommodation and public spaces are to be arranged:

.1 in the forepeak and afterpeak;

.2 in the spaces having direct exit through doors or manholes to spaces containing machinery, boilers, pressure vessels with flammable gas or to storerooms for flammable materials;

.3 in the spaces having common bulkheads with the tanks intended for fuel oil or lubricating oil.

10.2.2 Accommodation spaces may be located adjacent to machinery spaces on condition that complete gastightness of bulkheads is ensured.

The accommodation is to be separated from the holds by watertight bulkheads that extend up to the deck.

10.2.3 Location of accommodation and service spaces on ships intended for the carriage of flammable liquids is to comply with the requirements of 2.7 and 2.8, Part V "Fire Protection".

10.2.4 Where accommodation spaces are located on the sponsons, they are to be inboard of the sponson edge not less than 300 mm.

10.3 EXITS, PASSAGEWAYS AND STAIRWAYS

10.3.1 Living and sleeping quarters are to have at least two exits as far away from each other as possible which serve as escape routes. One of them may be designed as an emergency exit.

This does not apply to areas with an exit giving way directly onto the deck or into a corridor which serves as escape route, provided the corridor has two exits at a distance from each other and giving way onto port and starboard.

Emergency exits which may include skylights and windows are to have a clear opening of at least $0{,}6 \times 0{,}6$ m long or with a minimum clear diameter of 0,7 m and provide access to stairways.

On passenger ships the escape routes are not to pass through engine rooms or galleys except on ships of less than 25 m in length on which one escape route may pass through the galley.

The requirements to exits from engine rooms are specified in 4.5 Part VI "Machinery Installations".

10.3.2 On day trip ships, one of two exits from rooms or groups of rooms intended for 30 or more passengers or including berths for 12 or more passengers may be replaced by two emergency exits.

10.3.3 If rooms are located below the bulkhead deck, one of the exits may be a watertight bulkhead door, leading to an adjacent compartment from which the upper deck can be reached. The other exit shall lead directly or, if permitted in accordance with 10.3.2, as an emergency exit into the open air, or to the bulkhead deck.

This requirement does not apply to individual cabins.

10.3.4 On passenger ships escape routes and emergency exits are to be clearly signed. The signs are to be lit by the emergency lighting system.

10.3.5 Exits from rooms or group of rooms, as well as connecting corridors and passageways are to have a clear width of at least 0,8 m and also a clear height of at least 2,0 m for passenger ships and 1,9 m for other ships including the sill.

For doors of passenger and crew cabins and other small rooms, the clear width is to be of at least 0,7 m.

10.3.6 In the case of rooms or groups of rooms intended for more than 80 passengers the sum of the widths of all exits, as well as a clear width of the connecting corridors if they lead to rooms intended for more than 80 passengers, are to be at least 0,01 m per passenger.

If the total width of the exits is determined by the number of passengers, the width of each exit is to be at least 0,005 m per passenger.

10.3.7 Exits from rooms intended for use by persons with reduced mobility are to have a clear width of at least 0,9 m. Exits normally used for embarking and disembarking people with reduced mobility are to have a clear width of at least 1,5 m.

10.3.8 Where a part of the ship or room intended for passengers is served by a single connecting corridor or stairway, the clear width thereof is to be at least 1,0 m.

However on passenger sailing ships of less than 25 m in length the clear width of the connecting corridors, passageways and stairways may be 0,6 m.

10.3.9 In addition to the requirements of 10.3.5 and 10.3.8, the connecting corridors on passenger ships are to comply with the following requirements:

.1 they are to lead only to open decks, rooms or stairways;

.2 connecting corridors intended for use by persons with reduced mobility are to have a clear width of 1,3 m. Connecting corridors more than 1,5 m wide are to have hand rails on either side;

.3 dead ends in connecting corridors are to be no longer than 2,0 m;

.4 connecting corridors are to be free of steps.

10.3.10 The clear width of passageways and stairways leading to life-saving appliances is to be at least 0,8 m.

10.3.11 The clear width of a side deck as well as of the passageways and stairs leading to working spaces is to be at least 0,6 m.

The clear width of the passageway may be reduced to 0,5 m in the case of ships less than 8 m wide and in case of separate places for installation of equipment required for the ship operation. It may be reduced to 0,4 m at bollards and cleats.

10.3.12 Stairways leading to the passenger areas are to have a clear width of at least 0,8 m, or if they lead to connecting corridors or areas used by more than 80 passengers, at least 0,01 m per passenger.

Stairways intended for use by persons with reduced mobility are to have a clear width of at least 0,9 m and are not to run in a direction transverse to the ship.

10.3.13 On passenger ships, the stairways below the bulkhead deck are to be arranged inboard of the shell plating at a distance of at least 1/5 of the ship's breadth measured perpendicular to the centre line of the ship at the deepest draught level. This distance is not mandatory if at least one stairway is arranged on each side in the same place.

10.3.14 All between deck inclined stairways are to be of frame construction and made of steel or equivalent material approved by the Register (refer to 1.2, Part V "Fire Protection").

10.3.15 Stairways are to be installed at accesses to accommodation, working and public spaces where there is more than a 300 mm difference in floor level.

The construction of inclined, vertical and spar ladders is to provide:

.1 the step height of not more than 0,3 m;

.2 the step depth of not less than 0,15 m;

.3 the width of vertical ladders of not less than 0,3 m;

.4 non-slip surfaces of steps.

Stairs with more than three steps are to be fitted with hand-rails on both sides.

10.3.16 Each inclined stairway, before entrance to it and at the exit from it, is to be provided with a free landing having a width of not less than that of the stairway and a length of at least 0,8 m.

10.3.17 The inclination angle of the stairways intended for passengers on all ships and of those for crew on ships of more than 25 m in length is to be not more than 55° and the inclination angle of the stairways for crew on ships of less than 25 m in length — not more than 65°.

The inclination angle of the stairways intended for persons with reduced mobility is to be not more than 38°.

10.3.18 Cargo holds, forepeak and afterpeak areas, trunks, etc., are to be fitted with at least one vertical stairway or spar ladder.

Cargo holds may not be fitted with fixed means of access if at least two portable ladders with a width of 0,4 m in the upper part and 0,5 m at the base are provided. The length of the portable ladder is to be such that at least 3 steps are above the hatchway coaming at an inclination angle of 60°.

It is to be possible to ensure that portable ladders will not topple or skid.

10.3.19 Ships are to be fitted with a gangway at least 0,4 m wide and 4 m long, fitted with handrails on each side. The lateral parts of the gangway are to be marked with bright colour stripes.

On agreement with the Register, gangways shorter than 4 m may be permitted for small ships.

10.3.20 Special requirements for the location of stairway enclosures and protection of escape routes are given in 2.3, Part V "Fire Protection".

10.3.21 Self-propelled ships in **Zone 1** are to be fitted with a pilot ladder.

10.4 DOORS

10.4.1 Doors are to have locks and are to be so designed as to be operated from both sides. No accidental slamming of doors is allowed. The sauna doors are to have no locking devices.

10.4.2 Doors are to open as follows:

.1 doors of accommodation and service spaces giving access to a corridor, inwards the spaces;

.2 doors of public spaces, outwards or each side;

.3 outer doors in the end bullheads of superstructures and in external transverse bulkheads of deckhouses, outwards in the direction of the nearest side;

.4 outer doors in the external longitudinal bulkheads of deckhouses, outwards in the forward direction.

10.4.3 No sliding doors are to be fitted at exits and escape routs.

10.4.4 Doors of accommodation spaces are to have in their lower portions detachable panels of $0{,}4 \times 0{,}5$ m in size. These panels of passenger cabin doors are to be provided with the following inscription: "Emergency access — knock out in case of emergency".

Detachable panels are not required where the spaces are provided with opening type side scuttles of 400 mm in inner diameter or with deckhouse windows the smaller side of which being at least 400 mm and on condition that people may get to the corridor or open deck through these side scuttles or windows.

10.4.5 Glass doors in traffic areas and escape routes are to be manufactured of pre-stressed glass or laminated glass. They may also be made from a synthetic material, provided this is authorized for use in a fire-protection context and complies with the requirements of Section 2, Part V "Fire Protection".

10.5 GUARD RAILS

10.5.1 The outer edges of decks, superstructure and deckhouses areas accessible for the crew, as well as working spaces where people might fall and which are located at a height of more than 1 m, are to be fitted with bulwarks or with a guard rail, which is to comprise a handrail at least 0,90 m high. This requirement does not apply to unmanned ships and areas of cargo holds where the coaming is fitted with a handrail at a height of at least 0,9 m above the deck level.

On passenger ships, outer edges of decks intended for passengers are to be fitted with a bulwark or a guard rail, which is to comprise a handrail at least 1 m high. Bulwarks and guard rails of decks intended for use by persons with reduced mobility are to be at least 1,1 m high.

10.5.2 The bulwark, if arranged, is to meet the requirements of 2.13, Part II "Hull".

10.5.3 The distance between the stanchions of guard rails is to be not more than 1,5 m.

10.5.4 The opening below the lowest course of guard rails is not to exceed 230 mm. The other courses of rails are not to be more than 380 mm apart.

Guard rails of the decks accessible for passengers are to be provided with guard nets. The side of the net mesh is to be of not more than 100 mm.

10.5.5 On the water side, on decks having no guard rails or bulwark, the upper edge of the sheer strake is to extend by at least 50 mm above the deck. If the sheer strake does not extend above the deck, a waist timber or waterway plank of not more than 50 mm in height is to be provided.

10.5.6 In places where guard rails of bulwark are interrupted (in way of deck machinery, etc.) removable guard chains are to be provided.

10.5.7 On passenger sailing ships in areas where sails are handled detachable or collapsible guard rails are permitted.

10.6 EQUIPMENT OF DRY CARGO HOLDS

10.6.1 On single-bottom ships, wooded solid plating extending up to the ship's sides is to be placed on top of the bottom framing.

On double-bottom ships, wooden plating may be omitted. When such wooden plating is fitted, it is to be placed on battens of not less than 20 mm in thickness along the floors or on the inner bottom metal plating covered with a bituminous composition approved by the Register.

10.6.2 The plating may be made of separate sections or boards and in either case their ready removal is to be provided.

The thickness of plating made of pine wood is not to be less than 50 mm.

10.6.3 Where cargo is discharged by grabs or other mechanisms, the thickness of the wooden plating under cargo hatchways is to be doubled.

10.6.4 In holds intended for the carriage of general cargo, the side framing is to be protected by cargo battens made of wood or metal of not less than 25 mm in thickness and not less than 100 mm in width. The battens are to be attached to side framing so as to be readily removable and replaceable.

10.6.5 In holds intended for the carriage of dry and other bulk cargoes the wooden plating and side lining are to be fitted so as to prevent wells, bilges and suction pipes of the bilge system from clogging.

10.7 COMPONENTS OF HOISTING GEAR OF SHIPBORNE BARGES

10.7.1 Components of the hoisting gear of shipborne barges to be lifted by the crane on board the barge carrier (lugs, eye plates, rings, grips, etc.) are to be designed to withstand forces resulting from lifting the shipborne barge uniformly loaded with specification cargo and gripped in two points diagonally positioned. Under these forces the stresses in components of the hoisting gear are not to exceed 0,7 times the upper yield stress of their material.

10.8 VISIBILITY

10.8.1 A sufficiently clear view in all directions is to be ensured from the control station in the wheelhouse.

The sufficiently clear view is considered to be ensured if the following conditions are met:

.1 horizontal view from the helmsman's working place is to cover a sector of not less than 240°, and at least 140° of the sector is to be directly in front of the helmsman's working place. If, in spite of the specified field of view, the sufficiently unobstructed view cannot be ensured astern, the Register may require other measures to be taken, such as the installation of auxiliary optical devices;

.2 no window frames, masts, etc. are to be arranged directly in front of the helmsman's working place;

.3 in pushers and self-propelled push ships a clear view of coupling devices is to be ensured from the control station in the wheelhouse;

.4 a clear view through the front windows of the deckhouse is to be ensured at all times under all weather conditions (rain, snow, frost, etc.).

10.8.2 The view of the water surface from the ship's control station is not to be shadowed for a distance of more than 250 m from the bow of an unloaded ship. The use of optical or electronic devices (e.g periscope or CC TV system) to reduce the shadowed zone is neglected.

10.8.3 When complying with the requirements of 10.8.1.1 the helmsman is to be assumed to have a height of eye of 1650 mm above the deck at a steering position.

10.8.4 The upper edge of the forward facing windows of the wheelhouse is to be high enough to allow a person at the steering position with height of eye of 1800 mm a clear forward view to at least 10° above the horizontal at eye-level height.

10.8.5 To avoid reflections, the bridge front windows are to be glare-free and inclined from the vertical plane, so as to form an outward angle of not less than 10° and not more than 25°.

10.9 SPECIFIC REQUIREMENTS APPLICABLE TO HIGH-SPEED CRAFT

10.9.1 Seats and seat belts.

10.9.1.1 Seats are to be available for the permitted number of persons on board. The construction of the seats and their attachment to the ship structure are to comply with the requirements of 7.5, Part III "Equipment, Arrangement and Outfit" of Rules for the Classification and Construction of High-Speed Craft.

10.9.1.2 Fitting of seats with seat belts is to comply with the requirements of 7.6, Part III "Equipment, Arrangement and Outfit" of Rules for the Classification and Construction of High-Speed Craft.

Seat belts are optional if the Register is submitted a sufficient substantiation that they are not required.

10.9.2 Exits and evacuation routes.

10.9.2.1 An easy, safe and rapid access is to be ensured from the wheelhouse to the spaces and accommodation accessible to the public.

10.9.2.2 The evacuation routes leading to the safety exits are to be indicated clearly and permanently.

10.9.2.3 All concealed exits are to be adequately indicated. The means of operating the opening mechanisms of exit doors are to be clearly visible from the outside and from the inside.

10.9.2.4 An adequate space are to be provided beside the exits for a crew member.

10.9.3 Ensuring clear view.

10.9.3.1 Notwithstanding the requirements of 10.8.1, it is permitted to have the total arc of blind sectors from right ahead to 22,5° abaft the beam on either side not exceeding 20°. Each individual blind sector is not to exceed 5°. The clear sector between two blind sectors is not to be less than 10°.

10.9.3.2 Notwithstanding the requirements of 10.8.2, whatever the laden state, the blind area of vision forward of the bow from a seated position is not to be greater than the length of the ship.

10.10 MASTS, SPARS AND RIGGING OF PASSENGER SAILING SHIPS

10.10.1 General.

10.10.1.1 Masts, spars and rigging are to be made of high-quality material.

10.10.1.2 The parts of the rigging are to be arranged in such a way as to prevent unacceptable chafing.

10.10.1.3 Wood for masts and spars is to:

.1 be free of knot concentrations;

.2 be free of sapwood within the required dimension;

.3 as far as possible be straight-grained and contain as little as possible twisted growth.

10.10.1.4 If the chosen timber is either pitch pine or Oregon pine of quality level "clear and better" the diameters specified 10.10.2 to 10.10.7 may be reduced by 5 per cent.

10.10.1.5 If a material other than wood is used or if special types of rigging are used, such a design is to guarantee equivalent levels of safety with the dimensions and strength values laid down in the present Chapter. As evidence of the strength:

.1 a strength calculation is to be carried out, or

.2 confirmation of sufficient strength is to have been obtained from a recognized organization, or

.3 dimensioning is to be based on the procedures set out in a recognized regulatory framework (e.g. Middendorf, Kusk-Jensen).

10.10.1.6 If the timbers used for masts, topmasts, yardarms, booms and bowsprits are not round in cross-section, such timbers are to be of equivalent strength.

10.10.1.7 Mast pedestals, masts trunks and fastenings on deck, on floor-plates and on stem or stern are to be constructed in such a way that they can either absorb the forces they are subjected to or transfer them to other connected parts of the structure.

10.10.1.8 Wire cable connections are to take the form of splicings, compression sleeves or sealing sleeves. Splicings are to be marled and ends are to be whipped.

10.10.1.9 Eye spices of steel wire ropes and running rigging are to be provided with thimbles.

10.10.2 Masts.

10.10.2.1 The principal dimensions of wooden masts are to be determined according to Table 10.10.2.1.

Table 10.10.2.1

Length (distance from the cross-tree to the deck), in m	Diameter on deck, in cm	Diameter on the cross-trees, in cm	Diameter on the mast cap, in cm
10	20	17	15
11	22	17	15
12	24	19	17
13	26	21	18
14	28	23	19
15	30	25	21
16	32	26	22
17	34	28	23
18	36	29	24
19	39	31	25
20	41	33	26
21	43	34	28
22	44	35	29
23	46	37	30
24	49	39	32
25	51	41	33

Intermediate values are determined by interpolation.

10.10.2.2 If a mast has two yards, the diameters specified in 10.10.2.1 are to be increased by at least 10 per cent.

10.10.2.3 In the case of masts fitted through the deck, the diameter at the mast foot is to be at least 75 per cent of the diameter of the mast at deck level.

10.10.2.4 If a mast has more than two yards, the diameters specified in 10.10.2.1 are to be increased by at least 15 per cent.

10.10.2.5 Mast fittings, mast bands, cross-trees and mast caps are to be sufficiently strongly dimensioned and attached.

10.10.3 Topmast.

10.10.3.1 The principal dimensions of wooden topmasts are to be determined according to Table 10.10.3.1.

Table 10.10.3.1

Length without the masthead, in m	Diameter at the foot, in cm	Half-length diameter, in cm	Diameter at the level of the masthead fitting, in cm
4	8	7	6
5	10	9	7
6	13	11	8
7	14	13	10
8	16	15	11
9	18	16	13
10	20	18	15
11	23	20	16
12	25	22	17
13	26	24	18
14	28	25	20
15	31	27	21

Intermediate values are determined by interpolation.

10.10.3.2 If square sails are attached to a topmast, the dimensions specified in 10.10.3.1 are to be increased by 10 per cent.

10.10.3.3 The overlap between the topmast and the mast is to be at least 10 times the required foot diameter of the topmast.

10.10.4 Bowsprit.

10.10.4.1 The principal dimensions of a wooden bowsprit are to be determined according to Table 10.10.4.1.

Table 10.10.4.1

Total length, in m	Diameter at stem, in cm	Half-length diameter, in cm
4	14,5	12,5
5	18	16
6	22	19
7	25	23
8	29	25
9	32	29
10	36	32
11	39	35
12	43	39

Intermediate values are determined by interpolation.

10.10.4.2 The inboard section of the bowsprit is to have a length of at least four times the diameter of the bowsprit at the stem.

10.10.4.3 The diameter of the bowsprit at its head is to be at least 60 per cent of the diameter of the bowsprit at the stem.

10.10.5 Jib-booms.

10.10.5.1 The principal dimensions of jib booms are to be determined according to Table 10.10.5.1.

Table 10.10.5.1

Total jib boom length, in m	2	3	4	5	6	7	8	9	10
Diameter at the stem, in cm	7	10	14	17	21	24	28	31	35

Intermediate values are determined by interpolation.

10.10.5.2 The diameter of the jib boom at its head are to be at least 60 per cent of the diameter at the stem.

10.10.6 Main booms.

10.10.6.1 The principal dimensions of wooden main booms are to be determined according to Table 10.10.6.1.

Table 10.10.6.1

Total length of the main boom, in m	5	6	7	8	9	10	11	12	13	14	15	16
Diameter, in cm	14	15	16	17	18	20	21	23	24	25	26	27

Intermediate values are determined by interpolation.

10.10.6.2 The diameter at the swivel pin is to be at least 72 per cent of the diameter specified in 10.10.6.1.

10.10.6.3 The diameter at the clew is to be at least 85 per cent of the diameter specified in 10.10.6.1.

10.10.6.4 Where there is an angle of less than 65° between the main boom and the after leech and the main sheet is attached to the end of the boom, or the attachment point of the sheet is not abreast of the clew, the Register may require a greater diameter. The substantiation of the derogation is to be submitted to the Register.

10.10.6.5 For sail areas of less than 50 m^2, the dimensions set out in 10.10.6.1 may be reduced.

10.10.7 Gaffs.

10.10.7.1 The principal dimensions of gaffs are to be determined according to Table 10.10.7.1.

Table 10.10.7.1

Total length of the gaff, in m	4	5	6	7	8	9	10
Diameter, in cm	10	12	14	16	17	18	20

Intermediate values are determined by interpolation.

10.10.7.2 The unsupported length of the gaff is to be not more than 75 per cent.

10.10.7.3 The breaking strength of the crowfoot is to be at least equal to 1,2 times the breaking strength of the peak halyard.

10.10.7.4 The top angle of the crowfoot is to be a maximum of 60°. The derogation from this requirement is subject to special consideration by the Register in each case.

10.10.7.5 For sail area of less than 50 m^2 the Register may authorize reductions in the dimensions set out in 10.10.7.1.

10.10.8 Standing rigging.

10.10.8.1 Forestays and shrouds are to meet the minimum requirements according to Table 10.10.8.1.

Table 10.10.8.1

Mast length from the top or cross-tree to deck, in m	11	12	13	14	15	16	17	18
Tensile strength of the forestay, in kN	160	172	185	200	220	244	269	294
Tensile strength of the shrouds, in kN	355	415	450	485	525	540	630	720
Number of shroud cables and ropes per side	3	3	3	3	3	3	4	4

Intermediate values are determined by interpolation.

10.10.8.2 Backstays, topmasts, flying jib-stays, jib-booms and bowsprit shrouds:

.1 backstays, topmasts, flying jib-stays, jib-booms and bowsprit shrouds are to meet the requirements according to Table 10.10.8.2.1;

Table 10.10.8.2.1

Mast length from the top or cross-tree to the deck, in m	< 13	13 — 18	> 18
Tensile strength of the back-stay, in kN	89	119	159
Length of topmast, in m	< 6	6 — 8	> 8
Tensile strength of the flying jib stay, in kN	58	89	119
Length of jib-boom, in m	< 5	5 — 7	> 7
Tensile strength of the bowsprit shrouds, in kN	58	89	119

.2 the preferred rope design is to be based on Rope Construction Method 6 x 7 FE in the strength class 1550 MPa. All other properties of steel wire ropes are to be in compliance with the requirements of 3.5, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

Alternatively, at the same strength class, Construction Method 6 × 36 SE or 6 × 19 FE may be used. Because of the higher elasticity of Construction Method 6 × 19, the tensile strengths given in 10.10.8.2.1 are to be increased by 10 per cent. Use of a different rope design is to be permitted provided it has comparable properties;

.3 if rigid rigging is used, the required tensile strengths are to be increased by 30 per cent;

.4 for rigging only approved bolts, forks, round eyes, turnbuckles, eye-plates, bolts, rings and shackles etc. are to be used capable of being properly secured;

.5 the tensile strength of the bob stay is to be at least 1,2 times the tensile strength of the respective jib-stay and flying jib-stay;

.6 for ships with less than 30 m^3 water displacement, the Register may permit the reductions in tensile strengths set out in Table 10.10.8.2.6.

Table 10.10.8.2.6

Water displacement divided by the number of masts, in m^3	Reduction, %
> 20 to 30	20
10 to 20	35
< 10	60

10.10.9 Running rigging.

10.10.9.1 The minimum tensile strength and diameter for running rigging, in relation to the sail area, are to meet the following minimum requirements according to Table 10.10.9.1.

10.10.9.2 For running rigging, natural and synthetic fibre ropes or steel wire ropes are to be used.

If other ropes than specified in 10.10.9.1 are used the strength values given in Table 10.10.9.1 are to be complied with.

Fibre ropes of polyethylene are not to be used.

Synthetic and natural fibre ropes are to comply with the requirements of 6.6, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

10.10.9.3 Running rigging forming part of the staying is to have a tensile strength which corresponds to that of the respective stay or shrouds specified in 10.10.8.

10.10.10 Fittings and parts of the rigging.

10.10.10.1 If steel wire ropes or fibre ropes are used, the diameters of the rope sheaves (measured from the centre of rope to centre of rope) are to meet the following minimum requirements according to Table 10.10.10.1.

Table 10.10.10.1

Steel wire, in mm	6	7	8	9	10	11	12
Fibre, in mm	16	18	20	22	24	26	28
Rope sheave, in mm	100	110	120	130	145	155	165

Intermediate values are determined by interpolation.

10.10.10.2 The diameter of the rope sheaves may be equal to 6 times the diameter of the steel wire, provided that the steel wire does not constantly run over sheaves.

10.10.10.3 The tensile strength of the fittings (e.g., forks, round eyes, turnbuckles, eye-plates, bolts, rings and shackles) is to be compatible with the tensile strength of the standing or running rigging that is attached to them.

10.10.10.4 The fastenings of stay and shroud futtocks are to be designed to take up the forces they are subjected to.

Table 10.10.9.1

Type of running rigging	Rope material	Sail area, in m^2	Minimum tensile strength, in kN	Diameter of rope, in mm
Staysail halyards	Steel wire	up to 35	20	6
		> 35	38	8
	Fibre (polypropylene — PP)	Rope diameter of at least 14 mm and one rope sheave for every 25 m^2 of sails or part thereof		
Gaff sail halyards Top sail halyards	Steel wire	up to 50	20	6
		> 50 — 80	30	8
		> 850 — 120	60	10
		> 120 — 160	80	12
	Fibre (PP)	Rope diameter of at least 18 mm and one rope sheave for every 30 m^2 of sails or part thereof		
Staysail sheets	Fibre (PP)	up to 40	14	
		> 40	18	
	For sail areas of more than 30 m^2, the sheet is to take the form of a tackle or is to be capable of being operated by a winch			
Gaff/Top-sail sheets	Steel wire	< 100	60	10
		100 — 150	85	12
		> 150	116	14
		For top sail sheets, elastic connection elements (fore runners) are necessary		
	Fibre (PP)	Rope diameter of at least 18 mm and at least three rope sheaves. Where the sail area is greater than 60 m^2, one rope sheave per 20 m^2		

10.10.10.5 Only one shackle, along with the relevant stay or shroud may be attached to each eye.

10.10.10.6 Blocks of halyards and topping lifts are to be securely fastened to the mast, and the revolving crowfeet used for this purpose is to be in good condition.

10.10.10.7 Attachments eye bolts, cleats, belaying pins and fife-rails are to be designed to cope with forces they are subjected to.

10.10.11 Sails.

10.10.11.1 It is to be ensured that sails can be taken simply, swiftly and safely.

10.10.11.2 The sail area is to be appropriate for the type of ship and the water displacement.

10.10.12 Equipment.

10.10.12.1 Ships that are fitted with a jib-boom or a bowsprit are to have a jib net and an adequate number of appropriate holding and tensioning devices.

10.10.12.2 The equipment according to 10.10.12.1 may be dispensed with if the jib-boom or bowsprit is equipped with a hand becket and a foot rope adequately dimensioned to allow for the attachment of a safety harness to be carried on board.

10.10.12.3 For work on the rigging, a boatswain's chair is to be provided.

11 EMERGENCY OUTFIT

11.1 All manned ships, except pushed barges, are to be supplied with emergency outfit in accordance with Table 11.1.

11.2 For unmanned non-self-propelled ships emergency outfitmay be omitted.

11.3 The emergency outfit is to be stored in an emergency station situated above the freeboard deck.

On ships of less than 40 m in length it is allowed to locate the emergency station below the bulkhead deck on condition that free access to this station is provided.

Emergency station may be special space, box or place allocated on the deck or in spaces.

On ships of less than 20 m in length the emergency outfit may be stored in several stations.

11.4 The width of free passage in front of the emergency station is to be not less than 0,8 m. On ships of less than 30 m in length the passage width is to be at least 0,6 m.

Table 11.1

Nos	Item	Quantity depending on the ship's length, in m			Note
		from 71 to 140	from 30 to 70	below 30	
1	Soft lightening collision mat, 3,0 × 3,0, in pcs	1	1	—	Acc. to Table 9.5.1, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and construction of Sea-Going Ships
2	Thrummed collision mat, 2,0 × 2,0, in pcs	—	—	1	
3	Collision mat equipment, set	1	1	1	
4	Quick setting cement of grade not lower than 400, in kg	200	100	50	
5	Construction sand, kg	200	100	50	
6	Water glass (accelerator for concrete setting), kg	10	5	2,5	

Note. Collision mat equipment and requirements therefor in accordance with Section 9, Part III "Equipment, Arrangements and Outfit" of Rules for the Classification and Construction of Sea-Going Ships.

12 SIGNAL MEANS

12.1 GENERAL

12.1.1 The present Section establishes basic requirements, the ship's signal means are to comply with. The number of these means and their location on board ships of inland navigation are to meet, depending on the navigation area, the requirements of European Inland Navigation Rules or Main Regulations for the Danube Navigation.

12.2 SUPPLY OF SHIPS WITH SIGNAL MEANS

12.2.1 Ships of inland navigation are to be provided with electric navigation lights. Ships having no own sources of electrical power may be provided with lights using lighting kerosene or other sources of white light of type approved by the Register.

12.2.2 When using electric navigation lights, they are to be capable of being changed over to the emergency source of power in accordance with 9.3.1.2 and 6.7.1.2, Part IX "Electrical Equipment".

On ships where no emergency source of power is required, a spare set of oil lights is to be provided according to 3.3.1.

12.2.3 Sound signals used on ships are to be reliable in operation and are to produce the required sound intensity, duration and clear sounding of each blast.

12.2.4 Every ship is to be provided with the following spare parts and materials for lights:

.1 one light filter for each coloured light;

.2 one electric lamp for each electric light;

.3 one chimney for each pyronaphta light;

.4 one wick for each oil light.

For lights other than electric or oil ones, the composition of spare parts is to be determined by the Register, separately in each case.

12.3 CONSTRUCTION OF SIGNAL MEANS

12.3.1 Navigation lights.

12.3.1.1 Unless otherwise specified in the present Chapter, signal lights are to emit continuous and stable light.

12.3.1.2 To avoid varying range of visibility of navigation lights in the seas (blinking), the range of visibility in vertical plane of at least 5° is to be provided in either side from the horizontal plane going through the centre of the light source.

12.3.1.3 All the ship's navigation lights are to be reliable in operation under conditions specified in 2.1, Part IX "Electrical Equipment".

12.3.1.4 Navigation lights are to be manufactured of materials resistant to corrosion or have efficient anti-corrosive protective coating.

12.3.1.5 Electric lights are to be of safe type IP56. Lights are to be provided with an arrangement to ensure natural drainage of condensate outward.

12.3.1.6 Oil lights are to be of splashproof construction which prevents water splashes from getting into direct contact with chimney or burner.

Lights are to be of such design as to ensure natural drainage of water, adequate ventilation, normal burning of the lamp regardless of weather conditions and the ambient air temperature.

12.3.1.7 Ventilation of lights is to be carried out with the use of vent holes and ducts, the number, shape and location of which are to be such that the light does not smoke and does not die out under a wind velocity of 30 m/s and under the ship's motions.

12.3.1.8 The light case is to be of such design as to allow rapid change of electric or oil lamps. Oil lights are to be so constructed as to enable a lamp with its chimney fitted to be inserted into them.

12.3.1.9 Lamps are to be fitted in electric lights in vertical position. Provision is to be made to prevent the lamp and socket from their spontaneous loosening.

12.3.1.10 Oil lights are to be so constructed as to provide efficient securing of the oil cistern in the light case as well as to exclude the possibility of fitting a lamp of other purpose in the light.

12.3.1.11 The cistern capacity of the oil light is to be such that burning of the lamp is maintained during not less than 16 h.

12.3.1.12 Wicks in the burner tubes are to be fitted rather closely to provide an uniform lifting of the wick and normal draw-in of oil without reducing the lighting efficiency of the light.

12.3.1.13 Lighting kerosene having a flash point not lower than 40 °C is allowed for use as a fuel for the oil lights.

12.3.1.14 Inner surfaces of navigation lights are to be covered by a protective coating resistant to sea water and moisture and not affecting lighting characteristics of lights.

12.3.1.15 Navigation lights with coloured lights may be fitted with glasses or light filters coloured throughout their entire thickness or over the surface only.

The use of coloured lenses is subject to special consideration by the Register in each case.

Inner and outer surfaces of lenses and plain glasses are to be smooth, and the glass is to be free from foreign inclusions, blisters and chippings impairing the light characteristics.

Inner and outer surfaces of light filters are to be free from notches and indentations, at least, to the extent determined in the national standards agreed upon with the Register or in the specifications approved by the Register. The filter glass is to be free from blisters, foreign inclusions and drops.

12.3.1.16 Light filters may be manufactured of plastics provided all their characteristics are in all cases not inferior to those of glass filters.

12.3.1.17 Removable light filters of navigation lights are to be provided with wire reinforcement along their entire perimeter or with another equal protection against fractures and mechanical damages likely to occur in operation. Light filters in side navigation lights are to be so constructed as to prevent the possibility of placing the red filter instead of the green one into the starboard light, and vice versa.

12.3.1.18 Reflectors used in navigation lights are to have spherical shape and polished surface.

The reflector is to be so placed in the light that its curvature centre coincides with the optical centre of the lens. The reflection factor is to be not less than 50 per cent.

12.3.1.19 Navigation lights with coloured lights are to be painted in colour corresponding to the colour of the light.

12.3.1.20 Every light is to be marked in accordance with the national standards agreed with the Register.

12.3.1.21 Portable lights are to be fitted with handles for transportation and hoisting.

Where lights are to be lifted one under the other, they are to be fitted with a second handle at the bottom.

12.3.1.22 Construction of navigation lights other than electric or oil ones is to be considered by the Register in each case.

12.3.2 Flashing lights.

12.3.2.1 Flash light is to be an electric one, be fitted with the appropriate lenses and send separate or group flashing light signals in accordance with European Inland Navigation Rules or Main Regulations for the Danube Navigation.

It is recommended to use automatic devices to control the flashing light signals.

12.3.2.2 The light accompanying sound signals is to be an electric one and send the light signal simultaneously with actuation of the sound signal.

12.3.3 Signal shapes.

Signal shapes are to be provided with suitable devices for fixing them to halyards on which they are hoisted, and for joining with other shapes.

Folding shapes are to be fitted with devices retaining them in open position during hoisting and preventing the shapes from spontaneous folding.

Devices for joining the shapes one to another (except the cones) are to provide maintaining the specified distances between them.

12.3.4 Sound signal means.

12.3.4.1 For whistle sounding in fog it is recommended to provide special automatic controls ensuring time regulation of signal sounding and also to provide possible manual actuation of signals with automatic cutting-off of automatic controls at the moment of manual actuation.

12.3.4.2 The bell is to give a loud and clear sound and be manufactured of material not requiring protection against corrosion. No painting of the bell is allowed.

The bell intended for pushers and all other ships of 40 m in length and over is to have an outer diameter at the bell mouth of not less than 300 mm. The bell intended for ships of less than 40 m in length, except pushers, is to have an outer diameter at the bell mouth of not less than 200 mm. The mass of the striker is not to be less than 3 per cent of the bell mass.

12.4 FITTING OF SIGNAL MEANS ON BOARD THE SHIP

12.4.1 Navigation lights.

12.4.1.1 Navigation lights are to be fixed in stationary places provided for them or are to be hoistable with proper devices fitted on running rigging for their hoisting.

12.4.1.2 All navigation lights are to be so located that they can be distinctly visible within the arcs of visibility assigned to them by European Inland Navigation Rules and by Main Regulations for the Danube Navigation.

12.4.1.3 In all regular places where navigation lights are located, special devices are to be provided to ensure rapid and correct fitting and securing of the lights.

12.4.1.4 The accuracy of placing of the sectored light lights is to be checked by their position in relation to the centre line of the ship.

Horizontal position of lights is to be checked in relation to the fully loaded ship condition.

12.4.1.5 All masthead lights are to be protected by shields fitted below to preclude dazzling of people on the bridge and deck.

The shields are to be painted matt black.

12.4.1.6 Side lights are to be placed at the same height, in one line perpendicular to, and at the same distance from, the centre line of the ship.

12.4.1.7 Side lights at the side facing the centre line of the ship are to be protected by inboard shields with two transverse screens (fore and aft) perpendicular to the shield.

Shields are to be of such a length that the distance from the outer edge of the light lens or plain glass to the aft edge of the fore transverse screen will be 0,9 m at least.

The breadth of the fore transverse screen is to be such that a line connecting its outer edge to the inner edge of the filament or the light burner is parallel to the ship centre line.

The aft transverse screen is to be of such breadth as to mask completely the light from being seen across the stern, but not hinder showing its light to 22,5° abaft the beam.

The height of the shield and of the screens is not to be less than that of the light case. Shields are to be painted matt black on the inside.

12.4.2 Signal shapes.

Placing of signal shapes is to comply with the requirements of European Inland Navigation Rules and Main Regulations for the Danube Navigation.

12.4.3 Sound signal means.

12.4.3.1 Whistles or tyfons are to be fixed as high as possible above the uppermost deck and at least 0,5 m above superstructures and other structures on this deck, which can obstruct the propagation of sound. Their bellmouths are to be directed straight ahead.

12.4.3.2 Control buttons to actuate the whistle or tyfon are to be located at the steering stations of the ship.

12.4.3.3 The bell is to be placed stationary on the clear part of the forecastle deck.

12.4.4 Arrangements for storing signal means on board the ship.

12.4.4.1 The signal means not placed stationary and spare lights are to be stored on board in special readily accessible storerooms, chests or lockers which are recommended to be located near the wheelhouse.

12.4.4.2 Oil lights are to be stored in ready to use condition in lamp lockers fitted with metal shelves and devices for efficient securing of lights or in boxes made of non-combustible materials, which are especially provided for storing lights.

13 ADDITIONAL REQUIREMENTS FOR SHIPS CARRYING DANGEROUS GOODS

13.1 DRY CARGO SHIPS

13.1.1 Accommodation and service spaces.

13.1.1.1 The accommodation is to be separated from the holds by metal bulkheads having no openings.

13.1.1.2 Gastight closing appliances are to be provided for openings in the accommodation and the wheelhouse facing the holds.

13.1.1.3 No entrances or openings of the engines rooms and service spaces are to face the protected area.

13.1.1.4 Spaces the entrances or exits of which are partly or fully immersed in damaged condition are to be provided with an emergency exit not less than 0,1 m above the damage waterline. This does not apply to forepeak and afterpeak.

13.2 TANKERS OF TYPE G

13.2.1 The use of wood, aluminium alloys and plastic materials within the cargo area is permitted for:

gangways and external ladders;

masts and similar round timber.

The use of plastic materials or rubber within the cargo area is permitted for gaskets (e.g. for hatch covers, etc.).

13.2.2 The use of plastic materials for ship's boats is permitted only if the material does not readily ignite.

13.2.3 The lower edges of door-openings in the sidewalls of superstructures, and coamings of access hatches of under-deck spaces are to have a height of not less than 0,5 m above the deck.

This requirement need not be complied with if the wall of the superstructure facing the cargo area extends from one side of the ship to the other and has doors the sills of which have a height of not less than 0,5 m above the deck. The height of this wall is to be not less than 2 m. In this case, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches behind this wall are to have a height of not less than 0,1 m above the deck. However, the sills of engine room doors and the coamings of its access hatches are always to have a height of not less than 0,5 m.

13.2.4 The bulwarks, foot-rails, etc. are to be provided with sufficiently large openings which are located directly above the deck.

13.2.5 The bulkheads bounding the hold spaces shall be watertight. The cargo tanks as well as the bulkheads bounding the cargo area are to have no openings or penetrations below deck. The bulkhead between the engine room and service spaces within the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they comply with the requirements of 2.3.22, Part XIV "Requirements for Ships Carrying Dangerous Goods".

13.2.6 A space in the cargo area below deck may be arranged as a service space, provided that the bulkhead bounding this service space extends vertically to the bottom, and the bulkhead not facing the cargo area extends from one side of the ship to the other in one frame plane. This service space is only to be accessible from the deck.

This service space is to be watertight with the exception of its access hatches and ventilation inlets.

13.2.7 Where service spaces are located within the underdeck cargo space, they are to be arranged so that they are readily accessible and ensure the safe use of equipment therein for personnel in protective clothes and with an air-breathing apparatus. They are to be designed so as to allow an injured or unconscious personnel to be removed from such spaces without difficulty, if necessary by means of fixed equipment.

13.2.8 Hold spaces and other accessible spaces within the cargo area are to be arranged so as to ensure that they may be completely inspected and cleaned in an appropriate manner. The dimensions of openings, except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks, are to be sufficient to allow a person wearing breathing apparatus to enter or leave the space without difficulty. These openings are to have a minimum cross-sectional area of 0,36 m^2 and a minimum side length of 0,50 m. They are to be designed so as to allow injured or unconscious personnel to be removed from the bottom of such spaces without difficulties, if necessary by means of fixed equipment. In these spaces, the distance between the reinforcements is not to be less than 0,50 m. In double bottoms the distance may be reduced to 0,45 m. Cargo tanks may have circular openings with a diameter of not less than 0,68 m.

13.2.9 Accomodation spaces and the wheelhouse are to be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1 m above the bottom of ther wheelhouse may tilt forward.

13.2.10 Entrances to spaces and openings of superstructures are not to face the cargo area. Doors opening outward and not located in a recess the depth of which is at least equal to the width of the doors are to have their hinges facing the cargo area.

13.2.11 Entrances from deck and openings of spaces facing the weather deck are to be capable of being closed. The following instruction is to be displayed at the entrance of such spaces:

"DO NOT OPEN DURING LOADING, UNLOADING OR GAS-FREEING WITHOUT THE PERMISSION FROM THE MASTER. CLOSE IMMEDIATELY".

13.2.12 Entrances and windows of superstructures and accommodation spaces which can be opened, as well as other openings of these spaces are to be located not less than 2 m from the cargo area. No wheelhouse doors and windows are to be located within 2 m from the cargo area, except where there is no direct connection between the wheelhouse and the accommodation.

13.2.13 Spaces the entrances and exits of which are likely to become partly or completely immersed in the damaged condition, are to have an emergency exit which is situated not less than 0,1 m above the damage waterline. This does not apply to forepeak and afterpeak.

13.3 TANKERS OF TYPE C

13.3.1 The requirements of 13.2.1 to 13.2.4 and 13.2.8 to 13.2.13 are also applicable to tankers of type **C**.

13.3.2 The bulkheads bounding the cargo tanks, cofferdams and hold spaces are to be watertight. The cargo tanks and the bulkheads bounding the cargo area are to have no openings or penetrations below deck.

The bulkhead between the engine room and the cofferdam or service space in the cargo area, or between the engine room and a hold space may be fitted with penetrations provided that they comply with the requirements of 2.3.22, Part XIV "Requirements for Ships Carrying Dangerous Goods".

The bulkhead between the cargo tank and the cargo pump room below deck may be fitted with penetrations provided that the loading pipes are fitted with shut-off devices at the outlet of the cargo tank.

13.3.3 The cofferdam, the centre part of the cofferdam or other space below deck in the cargo area may be arranged as a service space provided the bulkheads bounding that service space extend vertically to the bottom. The service space is only to be accessible from the deck. The service space is to be watertight with the exception of its access hatches and ventilation inlets.

13.4 TANKERS OF TYPE N

13.4.1 The requirements of 13.2.1, 13.2.2 and 13.2.8 to 13.2.12 are applicable to tanker of type **N**. The requirements of 13.2.3 and 13.2.4 also apply to tanker of type **N** except open ships.

13.4.2 The engine room is to be accessible from the deck; the entrances shall not face the cargo area. Where the doors are not located in a recess whose depth is at least equal to the door width, the hinges are to face the cargo area.

13.4.3 Cofferdams or cofferdam compartments located next to the service space which has been arranged in accordance with 13.3.3 are to be accessible through an access hatch. Where the cofferdam is connected with the double bottom, an access from the latter to the cofferdam is adequate. Regarding the deck openings leading to the double bottom, the provisions of 12.2.4 apply. In this case, a possibility to assure from the deck that the cofferdam is empty, is to be provided.

13.4.4 An access hatch and ventilation inlets are to be located not less than 0,5 m above the deck.

APPENDIX

INSTALLATION TESTS OF LIFE-SAVING APPLIANCES

1 LAUNCHING DEVICES

1.1 After installation on board the ship, every launching device is to be subjected to lifeboat lowering and hoisting tests. The load in this case is to be taken in accordance with 8.4.2.2.

1.2 During the launching device tests the following is to be checked:

.1 cast components of the frame and arm by hammer-testing to determine that they are sound and without flaw;

.2 reliable application of the winch manual brake during lowering of the boat. Braking is to be smooth, but effective;

.3 smooth movement of rollers over the guides of the rolling off davit arms and boats;

.4 running of the falls across the sheaves and guide rollers as well as in the places covered by cases;

.5 uniform winding of the wire on the winch drum;

.6 necessary length of the falls for lowering the boat of each side down to the level of the lowest ballast waterline of the ship heeled to 10° either way;

.7 rope capacity of the winch drum (sufficient height of the drum flange on ends above the upper layer of completely laid down wire);

.8 operation of the hand gear to drive the davit winches, screw gear to drive the luffing davit;

.9 time required to lower the boat.

1.3 Turning-in of the davit arms is to be checked by multiple, at least, three times, turning-out and turning-in of the davit arms, lowering and hoisting of the boat with evenly distributed cargo equal to the mass of the full complement of equipment and operating crew.

Subject to checking in this case are:

.1 sufficiency of the mass of the loaded boat to overcome the frictional resistance of the falls, blocks, winches and associated gear;

.2 smoothness of the davit arms movement;

.3 smoothness of the rollers movement over the guides of the rolling off davits;

.4 force applied to the manual brake handle which is not to exceed 157 N;

.5 automatic cutting-off (interlocking) of the power of the electric drive when the hand gear with the handle put on is actuated;

.6 availability and regulation of limit switches.

2 LIFEBOATS

2.1 Mechanically propelled as well as motor life-boats are to be subjected to running trials in order to check the drive, motor, all systems and lights in use for their designated purposes.

PART IV. STABILITY, SUBDIVISION AND FREEBOARD

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part of the Rules apply to the ships subject to the Register technical supervision in compliance with the requirements of Part I "Classification" and sailing in displacement condition.

The requirements of the present Part of the Rules apply to skimmers, air-cushion vehicles, hydrofoils, catamarans and floating docks as far as it is reasonable and practicable.

Operation of ships in the areas where navigation conditions are different from those considered in the present Part of the Rules is subject to special consideration by the Register in each particular case.

1.1.2 The requirements of the present Part apply to ships in service as far as it is reasonable and practicable but they are, however, compulsory for ships which undergo reconstruction or major repair if their stability is impaired or freeboard is changed as a result.

1.1.3 The Register may impose additional requirements and allow reasonable deviations from the Rules requirements justified by the structural features of the ship or conditions of its operation.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to general terminology of the Rules are given in Part I "Classification".

For the purpose of the present Part of the Rules the following definitions have been adopted:

Wind pressure is an assumed design pressure of wind.

Stores are fuel oil, fresh water, provision, lubricating oil, expandable materials, etc.

Inclining Test Instructions are instructions on determination of the ship's displacement and center of gravity positions by means of the inclining test.

Weather criterion is a ratio of the capsizing moment to the heeling moment due to wind pressure.

Critical angle is the maximum permissible angle of heel equal to the angle at which water begins to fill the ship through unsecured openings, or at which the edge of the freeboard deck is submerged, or at which the middle of the bilge comes out of water, whichever is the less.

Heeling moments are assumed design values of statically and dynamically applied heeling moments corresponding to an adopted calculation scheme of their action on the ship.

Maximum permissible moments of mass are design values of maximum permissible moments based on condition of meeting stability requirements for the ship at its static or dynamic inclinations.

Freeboard (f) is the distance between the plane of maximum draught and a parallel plane passing through the lowest point of the gunwale or, in the absence of a gunwale, the lowest point of the upper edge of the ship's side.

Residual safety clearance is the vertical clearance available, in the event of the ship heeling over, between the water level and the lowest point of the immersed side, beyond which the ship is no longer regarded as watertight.

Residual freeboard is the vertical clearance available, in the event of the ship heeling over, between the water level and the upper surface of the deck at the lowest point of the immersed side or, if there is no deck, the lowest point of the upper surface of the fixed ship's side.

Openings considered as open are openings in the main deck or hull sides as well as in decks, sides and bulkheads of superstructures and deckhouses which do not have special weathertight closing appliances, strength and reliability of which meet the requirements of Section 9, Part III "Arrangements, Equipment and Outfit".

Windage lever is an elevation of windage centre (windage area center of gravity) above the actual waterline.

Windage area is the projected lateral area of the above-water portion of the ship on the center line plane with the ship in the upright position.

Correction for free surfaces is a correction to the initial value of metacentric height allowing for a decrease in the ship's stability due to the effect of free surfaces of liquid cargoes.

Margin line is an imaginary line drawn on the side plating not less than 10 cm below the bulkhead deck and not less than 10 cm below the lowest non-watertight point of the ship's side. If here is no bulkhead deck, a line drawn not less than 10 cm below the lowest line up to which the outer plating is watertight is to be used.

Maximum permissible angle of heel is an angle of heel which is not to be exceeded under the present Rules.

P l a n e o f m a x i m u m d r a u g h t is the water plane corresponding to the maximum draught at which the ship is authorized to navigate.

S a f e t y c l e a r a n c e is the vertical distance measured between the plane of maximum draught and the lowest point above which, disregarding water intakes and outlets, the ship cannot be deemed watertight.

L i g h t s h i p is a completed ship without cargo, stores and ballast water.

A n g l e o f f l o o d i n g is an angle of heel determined with no account of free trim at which the interior spaces of the ship are flooded with water through the openings considered to be open.

All side scuttles of the opening type are considered to be open.

C a p s i z i n g a n g l e is an angle of heel determined with no account of free trim upon reaching of which a ship capsizes under the effect of the applied heeling moment.

W i n d a g e c e n t r e is windage area centre of gravity.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 For every ship covered by the requirements of the present Part, the Register is to carry out:

.1 prior to the construction commencement:

review and approval of technical documentation relating to the ship's stability, subdivision and assignment of freeboard;

.2 during construction and trials of the ship:

technical supervision of the heeling test;

review and approval of Information on Stability;

and Damage Control Plan;

.3 in service — surveys:

to check for changes in loading of the light ship in the course of operation, repairs and modernization of the ship with the aim to make a conclusion whether Information on Stability is still applicable;

to make sure that no changes affecting the freeboard calculation and position of the load line marks were made in the hull, superstructures and deckhouses and that closing appliances for openings are maintained in proper condition.

1.4 GENERAL TECHNICAL REQUIREMENTS

1.4.1 All calculations are to be made by the methods generally accepted in naval architecture. In case of computer calculations, the calculation procedure and programme are to be approved by the Register.

1.4.2 The scale of the lines drawing is to be not less than 1:100, the greatest ordinate being at least 100 mm. The lines drawing scale is to be such that the ship's breadth is expressed by a segment of at least 300 mm.

1.4.3 Watertight compartments drawing is to contain data necessary for calculation of the centre of gravity positions of individual tanks filled with liquid cargoes and corrections for the free surface effect of liquid cargoes on stability.

1.4.4 For passenger ships area of the deck over which passengers can move and the maximum possible crowding of passengers on free deck areas with passengers accumulating on one side of the ship are to be indicated on deck plans.

1.4.5 Windage calculation.

1.4.5.1 The windage area is to include the projections of all continuous lateral surfaces of the ship's hull, superstructures and deckhouses on the center line plane; projections of masts, ventilators, boats, deck machinery, all tents that might be stretched in stormy weather as well as the projections of side surfaces of deck cargoes.

It is recommended that the projected lateral areas of discontinued surfaces of rails, spars (except for masts) and rigging as well as those of various small items be taken into account by increasing the total projected area of continuous surfaces calculated for the minimum draught by 5 per cent and the statical moment of this area by 10 per cent.

1.4.5.2 The approximate methods referred to in 1.4.5.1 for consideration of the projected lateral area of discontinued surfaces and small items are not compulsory. These items can be determined in more detail way where necessary. In such case, when calculating the projected lateral area of discontinued surfaces, such as spars and rigging of ships, rails, crane trusses of the lattice type, etc., the overall areas taken into consideration are to be multiplied by filling factors, the values of which are assumed as follows:

0,6 for rails covered with wire mesh;

0,2 for rails not covered with wire mesh;

0,5 for cranes of the lattice type;

0,6 for spars and rigging.

The projections of the above-water part of the hull, deckhouses and superstructures as well as discontinued surfaces indicated above are to be taken into account with a flow coefficient 1,0. The projections of circular section structures located separately on the deck are to be assumed to have a flow coefficient equal to 0,6.

1.4.5.3 The lever of windage area z_w is to be defined as a distance, in metres, between the centre of windage area and the actual waterline plane for the upright condition of the ship in smooth water. The centre of windage area is to be determined by a method generally applied for determination of the centre of gravity coordinates for a plane figure.

1.4.6 Stability curves are to be plotted, having regard to the effect of free surfaces of liquid cargoes.

A correction for the metacentric height for the effect of free surfaces of consumable liquid cargoes is to be calculated for 50 per cent filled tanks in the upright condition of the ship, irrespective of the filling assumed for weight load calculation.

A tank filled with a liquid for more than 95 per cent of its capacity is to be considered as totally filled.

Normal residues (up to 50 mm deep) of liquid cargoes in empty tanks are not to be taken into account in stability calculations.

Where the ship is intended for the carriage of various types of liquid cargoes, the most unfavourable combination thereof is to be taken into consideration.

1.4.7 Load conditions.

1.4.7.1 Stability is to be checked in the range of draughts to the load line mark under all load conditions indicated in Section 3 for ships of various types.

1.4.7.2 For ships of those types that are not covered by special provisions of Section 3, the following load conditions are to be checked:

.1 ship in fully loaded condition with full stores;

.2 ship without cargo, with 10 per cent of stores.

1.4.7.3 If the load conditions anticipated in normal service of the ship as regards stability are less favourable than those referred to in 1.4.7.2 or specified in Section 3, stability is to be also checked for those conditions.

1.4.7.4 The weight of solid ballast on board the ship is to be included in light-ship load condition.

Inclusion of ballast water in any load condition is to be agreed with the Register.

1.4.8 For all load conditions under consideration stability curves calculated with regard to the free surface effect of liquid cargoes are to be plotted.

1.4.9 Summary tables of calculation results for displacement, centre of gravity position, initial trim and stability as well as summary tables of the results of stability checking for compliance with the requirements of the present Part are to be compiled.

1.4.10 Requirements for Information on Stability.

1.4.10.1 To provide the adequate stability of the ship in service, Information on Stability approved by the Register and containing the following materials is to be issued to each ship:

.1 main particulars of the ship and information on stability for typical, predetermined load conditions;

.2 operational restrictions, weather restrictions, etc. necessary to ensure safety of the ship against capsizing and flooding;

.3 instructions, auxiliary diagrams, tables and other data in order to assess stability under load conditions possible in service but not predetermined;

.4 recommendations on arrangements contributing to the ship's stability improvement, including the information on tanks which may be filled with ballast water.

Compliance with the requirements of the present Part does not relieve the master of the ship from responsibility for stability of the ship in service;

.5 brief list of the requirements for stability and the diagram of the limiting gravity-center heights of the ship (limiting moments or minimum metacentric heights) plotted taking into account the requirements of the present Part;

.6 instructions for the master on proper securing of deck cargo, including containers, to prevent their shifting during ship heeling due to a dynamic wind action. Cargo of containers is only to be considered to be secured if each individual container is firmly attached to the hull of the ship by means of container guides or securing equipment and when its position cannot alter during the voyage.

1.4.10.2 Information on Stability for the ship, to which the subdivision requirements are applicable according to the present Part, is to additionally heeling the following information:

.1 information necessary to maintain the stability of an intact ship sufficient to withstand, in accordance with the requirements of this Part of the Rules, the most dangerous extent of the design damage; instructions on loading and ballasting the ship, including recommendations on distributing cargo, stores and ballast in a manner reasonable as regards the subdivision adopted and satisfying at the same time the requirements for trim, stability and strength of the ship; brief list of requirements for damage trim and stability;

.2 diagram of the limiting gravity-centre heights of the ship (limiting moments or minimum metacentric heights) plotted taken into account the subdivision requirements;

.3 list of results of flooding calculations including the parameters of a static stability curve under the worst flooding conditions;

.4 data on structural measures to ensure ship subdivision, instructions on the use of covers, cross flooding arrangements and emergency appliances, as well as on possible consequences of flooding relating to the particular features of the ship and on advisable and prohibited actions of the crew under normal conditions of service and in case of damage involving flooding.

1.4.10.3 Information on Stability is to be compiled on the basis of the results of stability calculations made in accordance with the Rules following the results of the heeling test of the ship.

For series-built ships Information on Stability is to be compiled according to the heeling test data of the first ship of each group consisting of five ships. Information on Stability compiled for the first ship of one group may be used for ships of another group, provided the heeling test results of the compared ships meet the following conditions:

.1 difference in light-ship displacement does not exceed 2 per cent, that in the height of centre of gravity is not more than 4 cm;

.2 the requirements of the present Part are met under the worst load conditions as regards stability, re-calculated on the basis of the heeling test results.

1.4.10.4 Information on Stability for floating cranes is to contain stability data for different outreaches of the boom and loads of different weight on the hook.

1.4.11 The ships, to which the subdivision requirements are applicable according to the present Part of the Rules, are to be provided with the Damage Control Plan approved by the Register.

Damage Control Plan is to be made on the scale acceptable for operation, but not less the 1:200. On passenger ships, the Plan is to be permanently exhibited on the navigating bridge. On cargo ships the Plan is to be permanently exhibited or be readily available on the navigating bridge. The Plan containing the longitudinal section, plans of decks, double bottom and transverse sections is to include:

boundaries of watertight compartments and tanks;

ballast, bilge, overflow (discharge) systems and arrangements to correct heel caused by flooding;

location of openings in watertight compartments, their closing appliances and the location of their local and remote controls, position indicators and alarms;

location of doors in the shell of the ship, position indicators, leakage detection and surveillance devices;

location of weathertight closing appliances above the bulkhead deck and on the lowest exposed weather deck, together with location of controls and position indicators, if applicable;

location of all bilge flood and ballast pumps, their control stations and valves.

1.4.12 In using the tables given in the Rules, intermediate values are to be obtained by linear interpolation.

1.5 INCLINING TEST

1.5.1 Inclining Test Report, calculations in connection with processing of the inclining test results as well as Light-Ship Displacement and Centre of Gravity Coordinates Calculation are to be submitted to the Register.

1.5.2 The following ships out of those indicated in 1.4.10.5 are to be inclined with subsequent centre of gravity position and stability calculation:

.1 series-built ships, i.e. first, sixth, eleventh ship, etc. that is every fifth ship of a series of ships under construction at each shipyard;

.2 every newly built ship of non-series construction;

.3 every ship after reconstruction, major repair, alteration or modernization, installation of solid ballast;

.4 ships which stability is unknown or gives rise to doubts.

1.5.3 Where the inclining test results for the series-built ship showed that the light-ship displacement of the ship changed by more than 2 per cent as compared to the first ship of the series, and the center of gravity position changed by more than 4 cm, such ship is to be considered, as regards stability, to be the first ship of a new series, and the procedure for the inclining test of subsequent ships is to meet the requirements of 1.5.2.1.

1.5.4 If after major repair, alteration, etc. the ship underwent structural changes resulted, as calculations showed, in the change of the light-ship displacement by less than 2 per cent, and the centre of gravity position changed by less than 4 cm, and structural changes did not result in violation of the requirements of the present Part, the inclining test is not required for such a ship.

1.5.5 On agreement with the Register, the inclining test may be omitted on the ships for which it can be shown by calculation that the ship has an adequate reserve of stability.

The lightweight and the centre of gravity of the ship intended for the carriage of dangerous goods are to be determined by means of the inclining test or by detailed mass and moment calculations. In the latter case, the lightweight is to be checked by means of the light-weight check with a resuling difference of not more than ± 5 per cent between mass determined by the calculation data and the displacement determined by the draught readings.

If during the inclining test it is not possible to achieve adequate heeling angles, or if the inclining test causes unreasonable technical difficulties, this may be replaced by a calculation of the floating equipment centre of gravity and weight. The result of the weight calculation is to be checked by measuring the draught, and the difference is not to exceed ± 5 per cent.

1.5.6 The inclining test is to be carried out in the load condition close to the light-ship displacement.

1.5.7 It is recommended that the inclining test be performed and the results be processed in compliance with the Inclining Test Instructions.

1.6 CONDITIONS OF SUFFICIENT STABILITY

1.6.1 Under the most unfavourable load conditions as regards stability, the stability of the ship is to meet the requirements of Section 2 and the additional requirements of Section 3.

2 GENERAL REQUIREMENTS FOR STABILITY

2.1 WEATHER CRITERION

2.1.1 The ship is to satisfy the weather criterion if, under the most unfavourable loading condition, the permissible moment produced by dynamic inclinations of the ship is equal to or greater than the heeling moment resulting from the dynamic pressure of the wind, i.e., if the following condition is met:

$$M_{perm} \geqslant M_{wd} \qquad (2.1.1)$$

where M_{perm} = permissible moment produced by the dynamic inclinations of the ship corresponding to the critical angle or to the capsizing angle, if the latter is smaller;
M_{wd} = heeling moment resulting from the dynamic pressure of the wind, as in 2.2.

2.2 CALCULATION OF THE HEELING MOMENT DUE TO WIND PRESSURE

2.2.1 The heeling moment M_{wd}, in kN·m, resulting from the dynamic pressure of the wind is to be taken as:

$$M_{wd} = 0{,}001 P_{wd} A_w l_w \qquad (2.2.1)$$

where P_{wd} = specific wind pressure, in Pa;
l_w = distance between the centre of gravity of the lateral area and the plane of the load waterline considered, when the ship is upright in calm water, in m.

2.2.2 The specific wind pressure value is to be taken from Table 2.2.2 for the navigation zone of the ship and for the lever arm.

Table 2.2.2

l_w, in m	1	2	3	4	5	6
Zones 1, 2	232	279	318	345	369	388
Zone 3	178	217	247	269	286	302

2.3 THE MAXIMUM PERMISSIBLE MOMENT IN CHECKING STABILITY FOR WEATHER CRITERION

2.3.1 The value of the heeling moment allowed by the Rules is determined by the value of the maximum permissible angle of heel. To be taken as the maximum permissible angle of heel θ_{perm} under the dynamic action of the heeling moment due to wind is either capsizing angle θ_c or critical angle θ_f, whichever is the less.

2.3.2 For ships in **Zones 2** and **3** the permissible moment M_{perm} corresponding to the critical or to the capsizing angle may be determined by means of a static or a dynamic stability curve in accordance with Figs. 2.3.2-1 and 2.3.2-2.

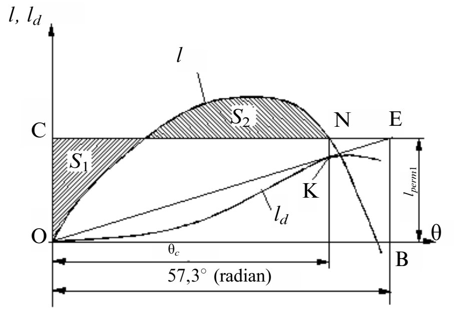


Fig. 2.3.2-1

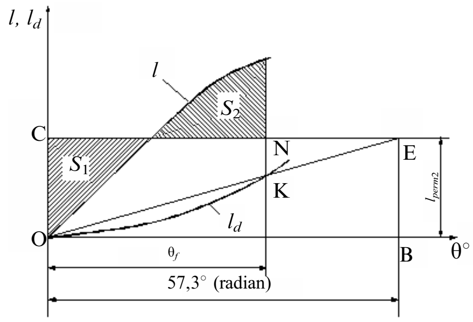


Fig. 2.3.2-2

In order to determine the maximum permissible moment M_{perm} corresponding to the appropriate capsizing angle θ_c, the tangent OK to the curve of levers of dynamic stability l_d is drawn from the origin of the coordinates of the static stability curve (point O in Fig. 2.3.2-1). The abscissa of the tangency point K gives, in this case, the value of the capsizing angle θ_c. Then, the segment OB equal to one radian (57,3°) is laid on the abscissa axis. From the point B the perpendicular BE is erected to its intersection with the tangent OK at the point E. The segment BE gives the numerical value of the lever l_{perm1} of the maximum permissible moment that corresponds to the determined capsizing angle of the ship. In this case, in order to determine the maximum permissible moment M_{perm1}, in kN·m, it is necessary to multiply the value of the lever l_{perm1}, in m, by the ship's displacement Δ, in kN, at the draught, for which the stability curve has been built, i.e.:

$$M_{perm1} = \Delta l_{perm1}. \qquad (2.3.2\text{-}1)$$

In order to determine the maximum permissible moment M_{perm2} corresponding to the angle of flooding θ_f, the value of this angle (Fig. 2.3.2-2) is to be laid off on the axis of abscissae and a perpendicular is erected from the point thus obtained to the intersection with the curve of levers l_d at the point K.

Further plotting is similar to the above, the difference being in that, instead of the tangent to the curve, the secant OK is drawn to its intersection at the point E with the perpendicular BE which is to be erected to the segment OB equal to one radian (57,3°). In this case, the segment BE gives the numerical value of the lever l_{perm2} of the determined maximum permissible moment corresponding to the angle of flooding of the ship.

The maximum permissible moment M_{perm2}, in kN·m, is obtained by multiplying the lever l_{perm2}, in m, by the ship's displacement, in kN, i.e.:

$$M_{perm2} = \Delta l_{perm2}. \tag{2.3.2-2}$$

The maximum permissible moment M_{perm1} or M_{perm2} is determined from the static stability curve as a result of plotting shown in Fig. 2.3.2-1 and Fig. 2.3.2-2. The straight line CN parallel to the axis of abscissae is so chosen on the static stability curve that cross-hatched areas S_1 and S_2 are equal.

The segment OC on the axis of ordinates of the curve shown in Fig. 2.3.2-1 gives the numerical value of the lever l_{perm1} of the maximum permissible moment that corresponds to the capsizing angle of the ship, and the value of this moment M_{perm1}, in kN·m, is determined by the Formula (2.3.2-1). Similarly the segment OC (refer to Fig. 2.3.2-2) gives the numerical value of the lever l_{perm2} of the maximum permissible moment corresponding to the angle of flooding of the ship, and the value of the moment M_{perm2}, in kN·m, is determined by the Formula (2.3.2-2).

2.3.3 The permissible heeling moment M_{perm} for ships intended for navigation in **Zone 1** is to be determined by means of a static or a dynamic stability curve in accordance with Figs. 2.3.3-1(*a*) — 2.3.3-2(*b*) taking into account the value for the amplitude of roll calculated as in 2.3.4.

Figs. 2.3.3-1(*a*) and 2.3.3-1(*b*) show static stability curves constructed taking into account the amplitude of roll θ_m in the following manner:

the curves are amplified by a static stability curve in the area of negative angles of heel to the abscissa θ_m (OD); in order to determine the maximum heeling moment, the area on the static stability diagram below the curve up to angle θ_{perm} angle (PRN) is to be equal to the area above the curve (PCD); the diagram in Fig. 2.3.3-1(*a*) shows a case in which the angle θ_{perm} equals the capsizing angle, and the diagram in Fig. 2.3.3-1(*b*) a case in which the angle θ_{perm} equals the permissible angle.

Figs. 2.3.3-2(*a*) and 2.3.3-2(*b*) show dynamic stability curves constructed taking into account the amplitude of roll θ_m in the following manner:

the curves are amplified by a dynamic stability curve in the area of negative angles of heel to the abscissa θ_m; a tangent to the dynamic stability curve is produced through new origin O′ in order to determine the maximum capsizing moment θ_{perm} (Fig. 2.3.3-2(*a*)), or a straight line is produced through the point of intersection of the dynamic stability curve with a vertical

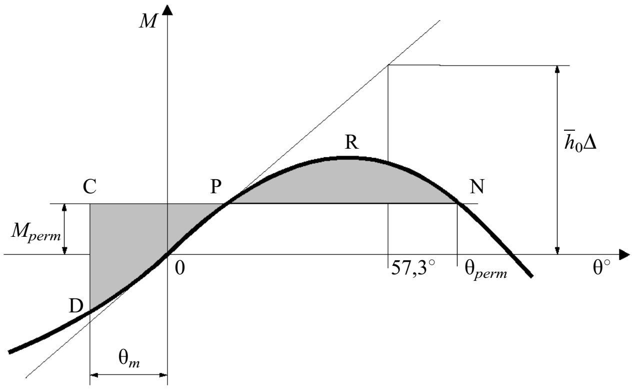


Fig. 2.3.3-1(*a*)

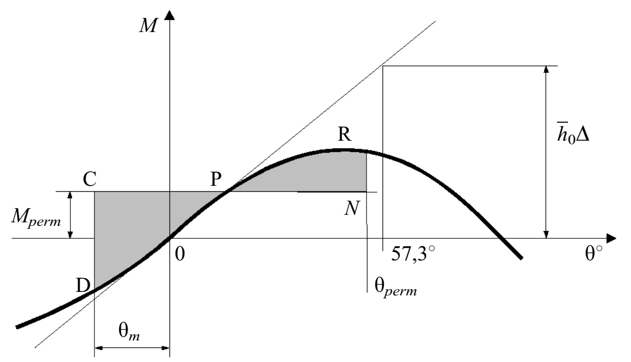


Fig. 2.3.3-1(*b*)

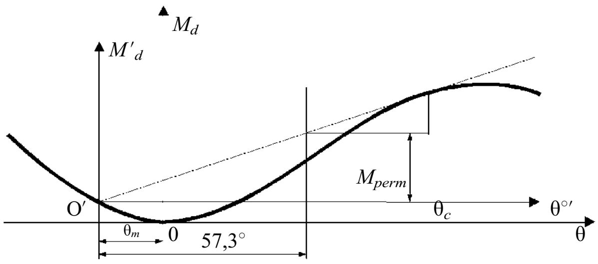


Fig. 2.3.3-2(*a*)

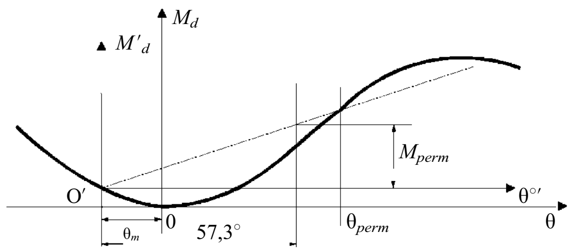


Fig. 2.3.3-2(*b*)

straight line drawn from the point of the angle of heel θ_{perm} which is permissible on other grounds; the segment at an angle of 1 radian gives the value of the maximum permissible heeling moment.

The permissible angle is to be taken to be the angle of heel at which water begins to fill the ship through unsecured openings in the side plating or on the deck. This angle is not to extend further than the upper edge of the side coaming of the cargo hatch or the upper edge of the expansion trunks of tankers.

2.3.4 Calculation of roll amplitude of a ship.

2.3.4.1 The value for the amplitude of roll θ_m of a flat-bottomed ship with a bilge radius of 0,05B or more is to be determined from Table 2.3.4.1 in terms of a value m, in 1/c, calculated by the formula

$$m = 0{,}66 \cdot k \cdot m_1 \cdot m_2 \qquad (2.3.4.1)$$

where k = coefficient considering the effect of bilge keels and/or bar keel and is determined in accordance with 2.3.4.5; the k value is to be taken as 1 if the ship is not fitted with keels;
m_1 and m_2 = factors determined in accordance with 2.3.4.2 and 2.3.4.3.

Table 2.3.4.1

m, in 1/c	0,40	0,60	0,80	1,00	1,20	1,40	1,60 or more
θ_m, in °	9	10	13	17	20	23	24

2.3.4.2 The factor m_1 is to be calculated by the formula

$$m_1 = \frac{m_0}{\sqrt{h_0}} \qquad (2.3.4.2\text{-}1)$$

where h_0 = initial metacentric height for the loading condition considered without correction for the free-surface effect of liquid cargo;
m_o = a value from Table 2.3.4.2 in relation to the parameter n_1 determined by the formula

$$n_1 = \frac{B_{wl} h_0}{z_g \sqrt[3]{h_0}} \qquad (2.3.4.2\text{-}2)$$

where B_{wl} = breadth of the ship's hull measured at the level of the waterline of floatation;
z_g = distance between the ship's center of gravity and base plane, in m;
Δ = the ship's displacement, in t.

Table 2.3.4.2

n_1	0,1 or less	0,15	0,25	0,50	0,75	1,00	1,50	2,00	2,50	3,0 or more
m_o	0,42	0,52	0,78	1,38	1,94	2,40	3,00	3,00	3,50	3,60

2.3.4.3 The non-dimensional factor m_2 is to be taken from Table 2.3.4.3 as a function of the ratio B/d.

2.3.4.4 In cases where the bilge radius is less than 0,05B, the value for the amplitude of roll determined in accordance with 2.3.4.1 may be reduced to a value of θ, in deg, determined by the formula

Table 2.3.4.3

B/d	2,5 or less	3,0	3,5	4,0	5,0	6,0	7,0	8,0	9,0	10,0 or more
m_2	1,0	0,9	0,81	0,78	0,81	0,87	0,92	0,96	0,99	1,0

$$\theta = \theta_m \left(0{,}75 + \frac{5r}{B_{wl}}\right) \qquad (2.3.4.4)$$

where r = bilge radius, in m.

2.3.4.5 For ships fitted with bilge or bar keels the k coefficient is determined according to Table 2.3.4.5-1 depending on the q parameter determined by the following formula:

$$q = r\alpha\sqrt{B_{wl}} \qquad (2.3.4.5)$$

where α = waterline area coefficient;
r = multiplier determined by the formula

$$r = (r_1 + r_2) r_3$$

where r_1, r_2, r_3 = coefficients selected from Tables 2.3.4.5-2 to 2.3.4.5-4 (where S_k is the total area of bilge keels or the bar keel lateral plane, in m^2; δ is block coefficient; and d is mean draught at the actual waterline, in m).

Table 2.3.4.5-1

q	0	1,0	2,0	3,0	4,0	5,0	6,0	7,0	$\geqslant$8,0
k	1,0	0,95	0,85	0,77	0,72	0,68	0,65	0,63	0,62

Table 2.3.4.5-2

$100S_k/L_{wl}B_{wl}$, %	0,70	1,0	1,50	2,0	2,50	3,0	3,50	$\geqslant$4,0
r_1	0,14	0,24	0,44	0,68	0,94	1,20	1,48	1,66

Table 2.3.4.5-3

δ	$\leqslant$0,45	0,50	0,55	0,60	0,65	0,70	0,75	0,80	$\geqslant$0,85
r_2	0	0,06	0,18	0,35	0,51	0,65	0,71	0,68	0,64

Table 2.3.4.5-4

B_{wl}/d	$\leqslant$2,50	3,0	4,0	5,0	6,0	7,0	8,0	9,0	$\geqslant$10,0
r_3	1,40	1,48	1,58	1,83	2,0	2,13	2,34	2,50	2,60

2.3.5 For vertical-sided ships calculations based on the stability curve may not be required if the heeling moment due to a wind pressure (refer to 2.2) does not exceed the maximum permissible moment, in kN·m, determined by the following formula:

$$M_{perm} = 0{,}0856 \Delta h \theta_{perm} \qquad (2.3.3)$$

where Δ = the displacement of the ship, in kN, at the draught to the actual waterline;
h = metacentric height, in m, calculated with regard to the correction for free surface effect of liquid cargoes;
θ_{perm} = maximum permissible angle at dynamic inclinations, in deg., that is assumed equal to the least angle out of the angles corresponding to the angle of flooding, angle at which the deck edge or sponson enter the water or angle at which the middle of the bilge comes out of the water, in deg.

2.4 METACENTRIC HEIGHT

2.4.1 The corrected initial metacentric height for all ships under all load conditions, including all stages of loading, unloading and the final load condition, except for the lightship condition, is not to be less than 0,2 m.

The metacentric height less than 0,2 m for the lightship condition are subject to special consideration by the Register in each particular case.

3 ADDITIONAL REQUIREMENTS FOR STABILITY

3.1 PASSENGER SHIPS

3.1.1 Stability of passenger ships is to be checked for compliance with weather criterion referred to in 2.1 for the following load conditions:

.1 in the fully loaded condition, 100 per cent passengers, 98 per cent fuel and fresh water, 10 per cent waste water;

.2 in the fully loaded condition, 100 per cent passengers, 50 per cent fuel and fresh water, 50 per cent waste water;

.3 in the fully loaded condition, 100 per cent passengers, 10 per cent fuel and fresh water, 98 per cent waste water;

.4 without cargo, 100 per cent passengers, 10 per cent fuel and fresh water, 98 per cent waste water;

.5 without cargo and passengers, 10 per cent fuel and fresh water, without waste water.

When checking stability for compliance with the weather criterion, it is assumed that berthed passengers are in their accommodation spaces and unberthed passengers are on their decks, and that cargoes are stowed in cargo holds and on decks in the same manner as under normal operarion conditions.

For all standard load conditions the ballast tanks are to be considered as either empty or full in accordance with normal operational conditions.

As a precondition for changing the ballast whilst under way, the requirement of 2.4 is to be proved for the following load condition:

100 per cent of passengers, 50 per cent fuel and fresh water, 50 per cent waste water, all other liquid (including ballast) tanks are considered filled to 50 per cent.

If this condition cannot be met, an entry is to be made in the Classification Certificate to the effect that, whilst under way, the ballast tanks can be empty or full and that, whilst under way, the ballast conditions is not to be changed.

For loading conditions referred to in 3.1.1.1, 3.1.1.2 and 3.1.1.3 the ship's stability is to meet additional requirements of 3.1.2 to 3.1.7. The residual freeboard measured on the shell plating is to be at least 200 mm under all conditions.

Stability of the ship in accordance with the additional requirements is also to be checked for the load condition when the number of passengers is not full, if such load condition may be less favourable than the worst out of those listed above.

3.1.2 The maximum righting lever l_{max} of the static stability curve is to occur at a heeling angle $\theta_{max} \geqslant 15°$ and is not to be less than 0,20 m. However, in case of $\theta_f < \theta_{max}$ the righting lever at the downflooding angle θ_f is not to be less than 0,20 m.

The downflooding angle θ_f is not to be less than 15°.

3.1.3 The area A under the curve of the righting lever is to, depending on the position of θ_f and θ_{max}, reach at least the following values:

		A
$\theta_{max}=15°$		0,07 m·rad to angle $\theta=15°$
$15° < \theta_{max} < 30°$	$\theta_{max} \leqslant \theta_f$	$0,055+0,001(30° - \theta_{max})$ m·rad to angle θ_{max}
$15° < \theta_f < 30°$	$\theta_{max} > \theta_f$	$0,055+0,001(30° - \theta_f)$ m·rad to angle θ_f
$\theta_{max} \geqslant 30°$ and $\theta_f \geqslant 30°$		0,055 m·rad to angle $\theta = 30°$

3.1.4 In application of the heeling moment due to passengers and wind according to 3.1.8 and 3.1.10 and in application of the heeling moment due to passengers and turning according to 3.1.8 и 3.1.11 the heeling angle is not to exceed 12°.

3.1.5 The heel resulting from one-sided accumulation of passengers in application of the heeling moment due to dynamic forces acting on the ship during the turning in accordance with 3.1.12, is not to exceed either the angle of the deck edge immersion (without taking into consideration the immersion of the ship's hull lines), or the angle at which the waterline situated 75 mm below the edge of the opening scuttles or other openings in the hull which are considered to be opened is immersed, whichever angle is the less.

3.1.6 For a heeling moment resulting from moments due to passengers, wind and turning according to 3.1.8, 3.1.10 and 3.1.11, the residual freeboard is to be not less than 200 mm.

3.1.7 For ships with scuttles or other openings in the hull located below the bulkhead decks and not closed watertight, the residual safety clearance is to be at least 100 mm on the application of the three heeling moments resulting from 3.1.6.

3.1.8 The heeling moment M_{h1}, in kNm, due to one-sided accumulation of passengers is to be calculated according to the following formula:

$$M_{h1} = gPy = g\Sigma P_i y_i \qquad (3.1.8)$$

where P = total mass of persons on board, in t, calculated by adding up the maximum permitted number of passengers and the maximum number of shipboard personnel and crew under normal operating conditions, assuming an average mass per person of 0,075t;
y = lateral distance of centre of gravity of total mass of persons P from centre line, in m;
g = acceleration of gravity (g = 9,81 m/s^2);
P_i = mass of persons accumulated on area A_i, in t;

$$P_i = n_i\, 0{,}075 A_i$$

where A_i = area occupied by persons, in m²;
n_i = number of persons per square meter;
n_i = 4 for free deck areas and deck areas with movable furniture; for deck areas with fixed seating furniture such as benches, ni is to be calculated by assuming an area of 0,45 m in width and 0,75 m in seat depth per person;
n_i = 6 for ships making voyages with a duration of less than 24 hours and also for ships used for mass carriage of passengers;
y_i = lateral distance of geometrical centre of area A_i from centre line, in m.

3.1.9 The calculation of moment M_{h1} is to be carried out for an accumulation of persons both to starboard and to port.

The distribution of persons is to correspond to the most unfavourable one from the point of view of stability. Cabins are to be assumed unoccupied for the calculation of the persons' moment.

The areas of outside passages formed by the bulwark or handrails are taken into account with coefficient 0,75 where the width of passages is from 0,7 to 1,0 m and with coefficient 0,5 where the width of passages is less than 0,7 m.

The areas of passages between settees (benches, seats) where passengers can crowd in addition to those sitting in their seats are taken into consideration with coefficient 0,5.

For the calculation of the loading cases, the centre of gravity of a person is to be taken 1 m above the lowest part of the deck at $1/2L_{WL}$, ignoring any deck curvature and assuming a mass of 0,075 t per person.

A detailed calculation of deck areas which are occupied by persons may be dispensed with if the following values are used:

$P = 1{,}1F_{\max}0{,}075$ for day-trip ships;
$1{,}5F_{\max}0{,}075$ for cabin ships

where $F_{\max}$ = maximum permitted number of passengers on board;

$y = B/2$, in m.

3.1.10 The heeling moment due to wind pressure M_{wst}, in kNm, is to be calculated as follows:

$$M_{wst} = p_w A_w (l_w + d/2) \qquad (3.1.10)$$

where p_w = the specific wind pressure of 0,25 kN/m^2;
A_w = lateral plane of the ship above the plane of draught according to the considered load conditions in m^2;
l_w = distance of the centre of gravity of the lateral plane A_W from the plane of draught according to the considered load conditions, in m.

3.1.11 The heeling moment due to centrifugal force M_{cf}, in kNm, caused by the turning of the ship, is to be calculated as follows:

$$M_{cf} = c_{cf}\, C_B\, v^2 \Delta / L_{WL}(z_g - d/2) \qquad (3.1.11)$$

where c_{cf} = a coefficient of 0,45;
C_B = block coefficient (if not known, taken as 1,0);
Δ = displacement, in t;
v = service speed of the ship, in m/s;
z_g = distance between the centre of gravity and the base line, in m.

For passenger ships with rudder-propeller, water-jet, cycloidal propeller or active bow-rudder propulsion systems, the M_{cf} value is to be derived from full-scale or model tests or else from corresponding calculations approved by the Register.

3.1.12 The heeling moment due to dynamic forces M_{cfd}, in kNm, acting on the ship during the turning is calculated as follows:

$$M_{cfd} = c_{cfd} v^2 \Delta / L_{WL}(z_g - a_d\, d) \qquad (3.1.12)$$

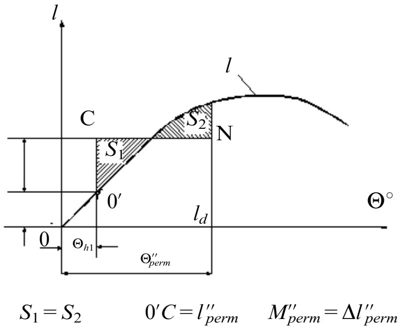
where c_{cfd} = a coefficient of 0,284;
Δ = displacement, in t;
a_d = a coefficient reflecting the elevation shift of the lateral pressure centre during the turning. This coefficient is derived from Table 3.1.12 depending on the B_{wl}/d ratio.

Table 3.1.12

B_{wl}/d	$\leqslant 2{,}50$	3,0	4,0	5,0	6,0	7,0	8,0	9,0	$\geqslant 10{,}0$
a_d	0,73	0,50	−0,27	−1,27	−2,33	−3,38	−4,45	−5,40	−6,00

The Formula (3.1.12) is valid for displacement single-hull ships with a relative speed $Fr = v/\sqrt{Lg} \leqslant 0{,}36$. In other cases the ship's stability during the turning is subject to special consideration by the Register.

3.1.13 The permissible heeling angle in accordance with 3.1.5 is determined from the static stability curve as a result of construction given in Fig. 3.1.13, where the origin of the coordinates is transposed to point O′ on curve l, corresponding to the static heeling angle θ_{h1} resulting from one-sided accumulation of passengers due to the application of the static moment M_{h1} determined in accordance with 3.1.8.



$S_1 = S_2$ $\quad 0'C = l''_{perm}$ $\quad M''_{perm} = \Delta l''_{perm}$

Fig. 3.1.13

3.1.14 Subdivision of passenger vessels.

The following definitions have been adopted in the present paragraph.

Bulkhead deck is the deck to which the required watertight bulkheads are taken and from which the freeboard is measured.

Length (L) is the maximum length of the hull, in m, excluding rudder and bowsprit.

Length of waterline (L_{WL}) is the length of the ship, in m, measured at the maximum draught.

Breadth (B) is the maximum breadth of the hull, in m, measured to the outer edge of the shell plating (excluding paddle wheels, rub rails, and similar).

3.1.14.1 It is to be proven by means of a calculation based on the method of lost buoyancy, that the damaged stability of the ship is appropriate. All calculations are to be carried out free to trim and sinkage.

3.1.14.2 Buoyancy of the ship in the event of flooding is to be proven for the standard load conditions specified in 3.1.1. Accordingly, mathematical proof of sufficient stability is to be determined for the three intermediate stages of flooding (25 per cent, 50 per cent and 75 per cent of flood build-up) and for the final stage of flooding.

3.1.14.3 Passenger ships are to withstand flooding with the damage located between two adjacent watertight bulkheads (one-compartment status) and anywhere along the ship's length (two-compartment status).

3.1.14.4 The assumptions concerning the extent of damage according to Table 3.1.14.4 are to be taken into account in the event of flooding.

Table 3.1.14.4

	One-compartment status	Two-compartment status
Dimension of the side damage		
longitudinal l, in m	$1{,}20 + 0{,}07L_{WL}$	
transverse b, in m	$B/5$	0,59
vertical h, in m	from ship bottom to top without delimitation	
Dimension of bottom damage		
longitudinal l, in m	$1{,}20 + 0{,}07L_{WL}$	
transverse b, in m	$B/5$	
vertical h, in m	0,59; pipework having no open outlet in a compartment is to be deemed intact	

3.1.14.5 For one-compartment status the bulkheads can be assumed to be intact if the distance between two adjacent bulkheads is greater than the damage length. Longitudinal bulkheads at a distance of less than $B/3$ from the outer plating measured perpendicular to center line from shell plating at the maximum draught are not to be taken into account for calculation purposes.

3.1.14.6 For two-compartment status each bulkhead within extent of damage will be assumed to be damaged. This means that the position of the bulkheads is to be selected in such a way as to ensure that the passenger ship remains buoyant after flooding of two or more adjacent compartments in the longitudinal direction.

3.1.14.7 The lowest point of every non-watertight opening (e.g., doors, windows, access hatchways) is to lie at least 0,10 m above the damaged waterline. The bulkhead deck is not to be immersed in the final stage of flooding.

3.1.14.8 Permeability coefficient is assumed to be 0,95. If a calculation proves that the average permeability of any compartment is lower than 95 per cent, the calculated value may be used.

The permeability coefficient values are not to be less than:

lounges — 0,95;

engine and boiler rooms — 0,85;

luggage and store rooms — 0,75;

double bottoms, fuel bunkers, ballast and other tanks — 0 or 0,95 (whichever produces more detrimental effect).

3.1.14.9 The calculation of free surface effect in intermediate stages of flooding is to be based on the gross surface area of the damaged compartments.

3.1.14.10 If damage of a smaller dimension than specified above produces more detrimental effect with respect to heeling or loss of metacentric height, such damage is to be taken into account for calculation purposes.

3.1.14.11 For all intermediate stages of flooding referred to in 3.1.14.2, the following criteria are to be met:

.1 the heeling angle φ at the equilibrium position of the intermediate stage in question is not to exceed 15°;

.2 beyond the heel in the equilibrium position of the intermediate stage in question, the positive part of the righting lever curve is to display a righting lever value of $GZ \geqslant 0{,}02$ m before the first unprotected opening becomes immersed or a heeling angle φ of 25° is reached;

.3 non-watertight openings are not to be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached.

3.1.14.12 During the final stage of flooding, the following criteria are to be met taking into account the heeling moment due to passengers in accordance with 3.1.8:

.1 the heeling angle φ_E is not to exceed 10°;

.2 beyond the equilibrium position the positive part of the righting lever curve is to display a righting lever value of $GZ_R \geqslant 0{,}05$ m with an area $A \geqslant 0{,}0065$ mrad. These minimum values for stability are to be met until the immersion of the first unprotected opening or in any case before reaching a heeling angle $\varphi_m = 25°$;

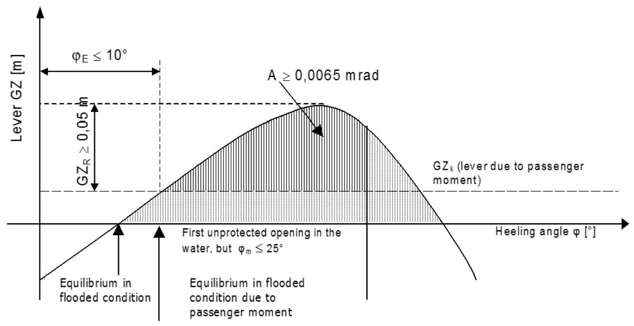


Fig. 3.1.14.12

.3 non-watertight openings are not to be immersed before the equilibrium position has been reached; if such openings are immersed before this point, the rooms affording access are deemed to be flooded for damaged stability calculation purposes.

3.1.14.13 If cross-flood openings to reduce asymmetrical flooding are provided, they are to meet the following requirements:

.1 the cross-flood openings and means of their control are to be approved by the Register;

.2 they are to be self-acting;

.3 they are not to be equipped with shut-off devices;

.4 the total time allowed for compensation is not to exceed 15 min.

3.1.14.14 Each watertight compartment on a passenger ship is to be fitted with a bilge level alarm approved by the Register.

3.1.15 Derogations for certain passenger ships.

3.1.15.1 As an alternative to proving adequate stability after damage according to 3.1.14, passenger ships with a length *L* of not more than 25 m, authorized to carry up to a maximum of 50 passengers, are to comply with the following criteria:

.1 after asymmetrical flooding, the immersion of the ship is not to exceed the margin line;

.2 the metacentric height GM_R is not to be less than 0,10 m.

3.1.15.2 The necessary residual buoyancy is to be assured through the appropriate choice of material used for the construction of the hull or by means of highly cellular foam floats, solidly attached to the hull. In the case of ships with a length *L* of more than 15 m, residual buoyancy can be ensured by a combination of floats and subdivision complying with one-compartment status.

3.1.15.3 Passenger ships with a length *L* of not more than 45 m and authorized to carry up to a maximum of 250 passengers may not comply with two-compartment status.

3.2 SERVICE BOATS AND NON-PASSENGER SHIPS CARRYING TEAMS OF WORKERS AND STAFF

3.2.1 Stability of service boats and non-passenger ships carrying teams of workers and staff is to comply with the stability requirements for passenger ships.

When checking stability of such ships on turning circle in accordance with 3.1.4 to 3.1.6, it is allowed to assume, in case where the number of passengers is less than 12, that all passengers are seated. This requirement is to be specially indicated in Information on Stability.

3.2.2 It is to be stated in Information on Stability that carriage of workers may not be combined with towing and technical operations.

3.3 CARGO SHIPS

3.3.1 Stability of dry cargo ships is to be checked for compliance with the weather criterion referred to in 2.1 under the load conditions specified in 1.4.7.1 and 1.4.7.3. Cargoes are to be stowed as under normal service conditions of the ship. The carriage of a non-secured deck cargo, including containers, therewith, is prohibited with an appropriate entry made in the Classification Certificate.

Stability of tankers is to be additionally checked for the case of 50 per cent filling of cargo tanks.

3.3.2 For all cargo ships the windage center of which is higher than 2 m above the actual waterline, stability is to be checked for the wind pressure capable to cause long inclination of the ship. In this case, stability is to meet the following condition:

$$M_{perm} \geqslant M_{wst} \qquad (3.3.2)$$

where M_{wst} = heeling moment due to wind pressure determined by the Formula (3.1.10), where the specific wind pressure is to be taken as 0,15 kN/m^2 for **Zone 3** and 0,25 kN/m^2 for **Zones 1** and **2**;

M_{perm} = maximum permissible moment produced by the static inclinations of the ship = moment corresponding to an angle of heel representing 80 per cent of the critical angle.

3.3.3 All ships for which the ratio of the total power of the main machinery Ne to the maximum permissible displacement Δ is $Ne/\Delta > 0{,}75$ kW/t are to be checked with respect to the turning criterion as in 3.1.11. Their heeling angle in this case is not to exceed 80 per cent of the critical angle.

3.3.4 Tankers of type **C** and **N** intended for the carriage of dangerous goods and having cargo tanks over 0,70*B* wide are to additionally comply with the following stability requirements.

3.3.4.1 In the positive area of the righting lever curve up to immersion of the first considered to be opened opening there is to be a righting lever of not less than 0,1 m.

3.3.4.2 The area under the righting lever curve up to immersion of the first considered to be opened opening, or up to the angle of heel equal to 27°, is to be not less than 0,024 m·rad.

3.3.4.1 and 3.3.4.2 are to be complied with considering all free surfaces in the ship tanks at all stages of loading and unloading.

3.3.5 In the case of the ship carrying non-fixed containers the ship's stability is to conform to the following requirements:

.1 the metacentric height h taking into consideration the free surface effect is not to be less than 1,0 m;

.2 under the combined action of the centrifugal force produced by the turning of the ship, the wind pressure and the free surfaces in tanks, the heel is not to be more than 5°, and the deck side is not to be submerged;

.3 the heeling arm h_{cf}, in m, resulting from the centrifugal force due to the turning of the ship is determined by the following formula:

$$h_{cf} = C_{cf}\frac{v^2}{L_{wl}}(z_g - d'/2) \qquad (3.3.5.3)$$

where C_{cf} = 0,04, in s^2/m;
v = maximum speed of ship in relation to the water, in m/s;
z_g = height of centre of gravity of loaded ship above the baseline, in m;
d' = draught of loaded ship amidships, m;

.4 the heeling arm h_{wst}, in m, resulting from the static effect of wind is determined according to the following formula:

$$h_{wst} = C_w\frac{A_w}{\Delta}(l_w - d'/2) \qquad (3.3.5.4)$$

where C_w= 0,025, in t/m^2;
Δ = displacement of a loaded ship;
l_w = height of centre of gravity of windage area A_w above the waterline, in m;
d' = draught of loaded ship amidships, in m;

.5 the heeling arm h_{fs}, in m, resulting from the free surfaces exposed to rainwater and residual water inside the hold or double bottom is determined according to the following formula:

$$h_{fs} = \frac{C_{sf}}{\Delta}\Sigma(bl(b - 0{,}55\sqrt{b}) \qquad (3.3.5.5)$$

where C_{fs} = 0,015 t/m^2;
b = breadth of hold or section of hold concerned, in m;
l = length of hold or section of hold concerned, in m;

.6 for each load, half the fuel and freshwater supply is to be taken into account;

.7 the actual z_g taking into consideration the free surface effect is not more than the $z_{g\max}$, produced by the Formulae (3.3.5.7-1) and (3.3.5.7-2). The $z_{g\max}$ is to be calculated for various displacements covering the whole range of possible draughts and the smaller value for $z_{g\max}$ is to apply.

$$z_{g\max} = \frac{z_M + \frac{B_{WL}}{2F}\left(C'_{cf}\frac{d_a}{2} - h_{wst} - h_{fs}\right)}{\frac{B_f}{2F}C'_{cf} + 1}; \qquad (3.3.5.7\text{-}1)$$

$$z_{g\max} = z_M - 1{,}0 \qquad (3.3.5.7\text{-}2)$$

where for $B_{WL}/2F$, no value below 11,5 is to be used (11,5 =1/tg5°);
C'_{cf} = 0,04v^2/L_{wl};
$z_{g\max}$ = maximum permissible height of the centre of gravity of the ship above the baseline, in m;
z_M = transversal height of metacentric above the baseline according to the approximation Formulae (3.3.5.8-1) or (3.3.5.8.-2), in m;
F = actual freeboard at 1/2L, in m;
v = maximum speed of ship, in m/s;
d_a = average draught, in m;
h_{wst} = heeling arm resulting from the static effect of wind determined by the Formula (3.3.5.4), in m;
h_{fs} = sum of the heeling arms produced by free surfaces according to determined by the Formula (3.3.5.5), in m;

.8 where there are no hydrostatics available, the value of z_M, in m, for the calculation, may be determined by the following approximation formulae:

for pontoon ships

$$z_M = \frac{d_a B_{wl}^2}{(12{,}5 - d_a/H)} + d_a/2; \qquad (3.3.5.8\text{-}1)$$

for other ships

$$z_M = \frac{d_a B_{wl}^2}{(12{,}7 - 1{,}2d_a/H)} + d_a/2. \qquad (3.3.5.8\text{-}2)$$

3.3.6 In the case of ships carrying fixed containers, the ship is to conform to the following requirements:

.1 the metacentric height h taking into consideration the free surface effect is to be not less than 0,50 m;

.2 under the combined action of the centrifugal force produced by the turning of the ship, the wind pressure and the free surfaces, no hull opening is to be submerged; the heeling arm resulting from the centrifugal force produced by the turning of the ship, the wind pressure and the free surfaces are to be determined by the formulae referred to in 3.3.5.3 to 3.3.5.5;

.3 for each load, half the fuel and fresh water supply is to be taken into account;

.4 the actual z_g taking into consideration the free surface effect is not more than the $z_{g\max}$, produced by the Formulae (3.3.5.7-1) and (3.3.5.7-2). The $z_{g\max}$ is to be calculated for various displacements covering the whole range of possible draughts and the smaller value for $z_{g\max}$ is to apply.

$$z_{g\max} = \frac{z_M - \frac{I-i}{2\nabla}\left(1 - 1{,}5\frac{F}{F'}\right) + 0{,}75\frac{B_{wl}}{F'}\left(C'_{cf}\frac{d_a}{2} - h_{wst} - h_{fs}\right)}{0{,}75\frac{B_{wl}}{F'}C'_{cf} + 1}; \qquad (3.3.6.4.\text{-}1)$$

$$z_{g\max} = z_M - 0{,}50 \qquad (3.3.6.4\text{-}2)$$

where for B_{wl}/F' no value below 6,60 is to be used;
for $[(I-i)/2\nabla]\cdot(1-1{,}5F/F')$ no value below 0,0 is to be used;
I = transverse moment of inertia of the waterline area at d_a, in m^4;
i = transverse moment of inertia of the waterline area parallel to the base plane at a height $d_a+2/3F'$, in m^4;
∇ = ship's displacement at d_a, in m^3;
F' = ideal freeboard $F'=H'-d_a$, in m, or $F'=(aB_{wl})/2b$, in m, the smaller value is to apply;
a = vertical distance between the lower edge of the opening corresponding to the minimum flooding angle and the ship's waterline in the upright position, in m;
b = distance from that opening to the center-line plane, in m;
H' = ideal height of the side $H'=H+q/(0{,}9LB_{wl})$, in m;
q = sum of volumes, in m^3, of the deckhouses, hatches, deck lockers and other superstructures having a maximum height of up to 1,0 m above the height of the side H or to the lowest opening in the considered volume, whichever is lower. The parts of volumes located within a range of $0{,}05L$ from the extreme points of the ship' hull are not to be considered.

Where there are no hydrostatics available, the value of I, in m^4, may be determined by the following approximation formulae:

for pontoon ships:

$$I=\frac{B_{wl}^2\nabla}{(12{,}5-d_a/H)d_a};$$

for other ships:

$$I=\frac{B_{wl}^2\nabla}{(12{,}7-1{,}2d_a/H)d_a}$$

3.3.7 Each watertight hold on each ship is to be fitted with a bilge level alarm approved by the Register.

3.3.8 Subdivision of cargo ships intended for the carriage of dangerous goods.

3.3.8.1 Under all load conditions to be encountered in service and which are in agreement with the purpose of the ship, the trim and stability of an intact ship are to be sufficient for satisfying damage trim and stability requirements.

3.3.8.2 Calculations to confirm compliance with damage trim and stability requirements are to be performed for such a number of loading conditions to be encountered in service and being the most unfavourable from the point of view of trim and stability (within operational draughts of ship), such distribution and extent of damage determined in 3.3.5.4, 3.3.5.5 and 3.5.5.8, that proceeding from those calculations one could assure that in all other cases the damaged ship would be in a better condition as regards damage stability, the residual freeboard, distance from a damage waterline to openings through which the ship may be flooded and heeling angles.

3.3.8.3 Calculations to confirm compliance with damage trim and stability requirements are to be performed for both the final stage of flooding and critical intermediate stages of flooding.

3.3.8.4 Except for the cases specially provided for, the following extent of damage are to be assumed in calculations of damage trim and stability:

side damage:

longitudinal extent: $0{,}10L$, but not less than 5,00 m;

transverse extent: 0,59 m;

vertical extent: from the baseline upwards without limit;

bottom damage:

longitudinal extent: $0{,}10L$, but not less than 5,00 m;

transverse extent: 3,00 m;

vertical extent measured at centerline from the moulded line of hull: 0,49 m, the sump excepted.

3.3.8.5 Damage trim and stability requirements are to be satisfied for the following locations of side and bottom damages:

side damage — anywhere in the ship's length except the engine room. Such engine room is to be considered as a separate floodable compartment. All the bulkheads within the damage area are to be considered as damaged;

bottom damage — anywhere in the bottom.

3.3.8.6 In damage trim and stability calculations, the permeability of a flooded space is to be assumed equal to 0,95. Where the average permeability of a particular compartment according to a special calculation is less than 0,95, it may be used in the damage trim and stability calculations. The special calculation of permeability is to be submitted to the Register for approval. However, the permeability is not to be assumed less than the following minimum values:

0,85 — for an engine room;

0,95 — for accommodation spaces;

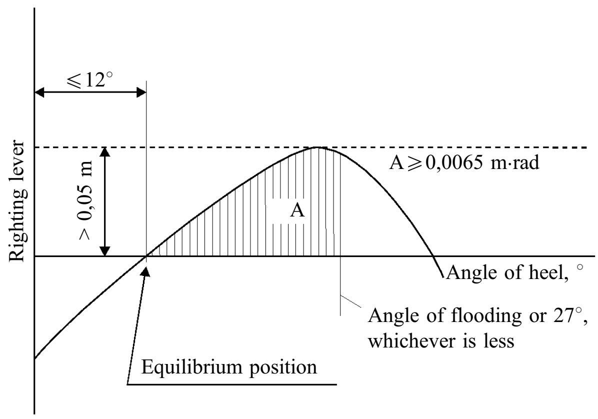
0 or 0,95 (whichever results in the more severe requirement) — for double bottoms, fuel oil tanks, ballast tanks, etc.

3.3.8.7 Requirements for damage trim and stability characteristics.

3.3.8.7.1 In the final stage of flooding, the initial metacentric height of a ship in the upright condition determined by the constant displacement method is to be positive.

3.3.8.7.2 A heeling angle in the final stage of flooding is not to exceed 12°.

3.3.8.7.3 The righting lever curve of a damaged ship (Fig. 3.3.8.7.3) is to have a sufficient positive righting



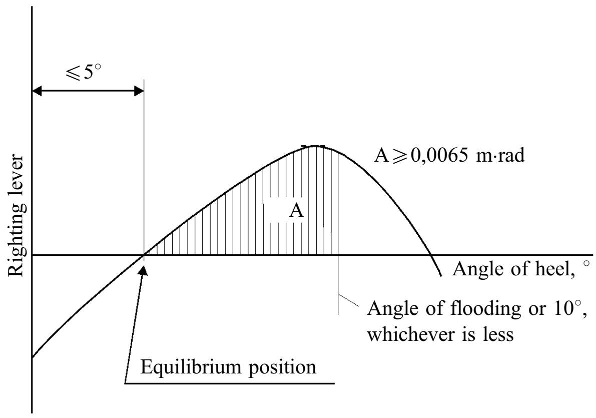
3.3.8.7.3

arm section within angles of heel from 0° to 27° (flooding angle considered). In this case, the maximum righting arm of the curve is to be at least 0,05 m, the positive righting arm section within the said extent is not to be less than 0,0065 m·rad. The angle of submersion of the openings, considered as open, through which water may spread to the undamaged compartments is to be taken as flooding angle.

3.3.8.7.4 When cross-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalization is not to exceed 15 min.

3.3.8.7.5 In intermediate stages of flooding, the maximum righting arm of a righting lever curve is to be at least 0,05 m, and the length of its positive part is to be not less than 7°.

3.3.8.7.6 Before, during and after equalization the damage waterline is to be by at least 0,10 m below the openings, being closed by means of weathertight covers, through which through which water may spread to the undamaged compartments (e.g. doors, windows, access hatches).



3.3.8.8.1.2

3.3.8.8 Additional requirements for damage trim and stability

3.3.8.8.1 Inland navigation ships carrying loose containers.

3.3.8.8.1.1 A heeling angle in the final stage of flooding is not to exceed 5°.

3.3.8.8.1.2 The righting lever curve of a damaged ship (Fig. 3.3.8.8.1.2) is to have a sufficient positive righting arm section within angles of heel from 0° to 10° (flooding angle considered). In this case, the maximum righting arm of the curve is to be at least 0,05 m, the positive righting arm section within the said extent is not to be less than 0,0065 m•rad. The angle of submersion of the openings, considered as open, through which water may spread to the undamaged compartments is to be taken as flooding angle.

3.3.8.8.2 Tankers of type **G**, **C** and **N**.

The following extent of damage is to be assumed in calculations of damage trim and stability:

.1 side damage:

longitudinal extent: 0,10*L*, but not less than 5,00 m;

transverse extent: 0,79 m;

vertical extent: from the baseline upwards without limit;

.2 bottom damage:

longitudinal extent: 0,10*L*, but not less than 5,00 m;

transverse extent: 3,00 m;

vertical extent measured at centerline from the moulded line of hull: 0,59 m, the sump excepted.

3.3.9 Subdivision of ships longer than 110 m.

3.3.9.1 The requirements of this paragraph apply to ships that are longer than 110 m, with the exception of passenger ships.

3.3.9.2 The proof of sufficient stability, including stability after damage, is to be verified for the most unfavourable load condition.

3.3.9.3 The proof of buoyancy after damage is to be verified for the fully laden ship.

3.3.9.4 Calculated proof of sufficient stability is to be established for the critical intermediate stages of flooding and for the final stage of flooding. Verification of sufficient stability in intermediate stages is subject to special consideration by the Register.

3.3.9.5 Damage extent:

.1 extent of side damage:

longitudinal extent, in m — 0,10*L*;

transverse extent — 0,59 m;

vertical extent — from the base line upwards without limit;

.2 extent of bottom damage:

longitudinal extent, in m — 0,10*L*;

transverse extent — 3,00 m;

vertical extent — from the base line 0,39 m upwards, the sump excepted.

3.3.9.6 In the case of side damage trim and stability requirements are to be fulfilled with the damage located anywhere along the ship length, except for the engine room. Such engine room is considered as a separate flooded compartment.

3.3.9.7 In the case of bottom damage trim and stability requirements are to be fulfilled with the damage located anywhere along the ship bottom.

3.3.9.8 Permeability coefficient is to be assumed to be 0,95. If a calculation proves that the average permeability of any compartment is lower than 95 per cent, the calculated value may be used. However, the permeability coefficient values are not to be less than:

engine and boiler rooms — 0,85;

double bottoms, fuel bunkers, ballast tanks and other tanks — 0 or 0,95 (whichever produces more detrimental effect).

3.3.9.9 The lowest edge of any non-watertight opening (e.g., doors, windows, access hatches) at the final stage of flooding is to be not less than 100 mm above the damaged waterline.

3.3.9.10 At the final stage of flooding, the heeling angle is not to exceed 5°.

3.3.9.11 The ship stability after damage is to comply with the requirements of 3.3.8.7.1 and 3.3.8.7.3.

3.3.9.12 When cross- or down-flooding openings are provided for reduction of asymmetrical flooding, the time for equalization is not to exceed 15 min. The stability in the intermediate stages of equalization is to be in accordance with 3.3.8.7.6. The lowest edge of any non-watertight opening (e.g., doors, windows, access hatches) during equalization is to be not less than 100 mm above the damaged waterline during the process of.

3.3.9.13 The maximum draught level is to be established basing on compliance with the requirements of 3.3.9.2 and 3.3.9.3.

3.3.10 Subdivision of ships in service.

3.3.10.1 Ships in service are to comply with the requirements of 3.1.14, 3.1.15 and 3.3.9 not later than on the date of the first renewal survey after 1 January 2045.

Tankers of type **N** in service are to comply with the requirements of 3.3.9 not later than on the date of the first renewal survey after 1 January 2038.

3.3.10.2 If a ship in service undergoes conversion, or part of its structure (or equipment) is replaced by new one, both such conversed and new parts of the existing ship are to comply with the requirements of 3.1.14, 3.1.15 and 3.3.9. If the ship's structures and equipment are replaced by the equipment or structures of the same type, or by the equipment using the same technologies as before the conversion, compliance with the requirements of 3.1.14, 3.1.15 and 3.3.9 may be waived.

3.4 TUGS

3.4.1 Stability of tugs is to be checked for compliance with weather criterion referred to in 2.1 and with additional requirements of 3.4.1 to 3.4.5 under the load conditions listed in 1.4.7.2 and 1.4.7.3.

Stability of other types of ships having a towing arrangement is to be checked for the effect of the tow line jerk in compliance with the requirements of 3.4.2 to 3.4.5 for the load condition in which towage takes place.

3.4.2 Stability of all tugs is considered to be sufficient, provided the following condition is met:

$$M_{perm} \geqslant M_v + M_t \qquad (3.4.2)$$

where M_{perm} = maximum permissible heeling moment, in kN·m, determined in compliance with 2.3.2;
M_v = heeling moment, in kN·m, due to wind pressure, determined in compliance with 2.2.1;
M_t = heeling moment, in kN·m, due to the side component of the tow pull, determined in compliance with 3.4.3.

3.4.3 The heeling moment M_t is to be determined by the following formula:

$$M_t = 1{,}1T(z_t - d) \qquad (3.4.3)$$

where T = maximum tow pull, in kN, to be determined during mooring tests;
z_t = elevation, in m, of the application point of the tow pull above the base plane.

In cases where T is unknown, upon agreement with the Register, the following values may be adopted for calculation purposes:

with $\Delta \leqslant 30$ t:

$T = 0{,}13N_e$ – for tugs without a nozzle;

$T = 0{,}20N_e$ – for tugs with a nozzle;

with $\Delta > 30$ t:

$T = 0{,}16N_e$ for tugs without a nozzle;

$T = 0{,}20N_e$ for tugs with a nozzle

where N_e is a total power of the main machinery, in kW.

3.4.4 When checking stability of tugs according to 3.4.2, the angle of flooding is to be determined assuming that all side scuttles, doors and companionways leading to the spaces located below the open deck, whatever their construction may be, are considered to be open.

3.4.5 Stability of a tug is to meet the following additional requirement:

the angle of heel under the combined effect of heeling moments due to wind pressure (2.2.1) and due to the action of a centrifugal force (3.1.11) during turning is not to exceed the angle of flooding or the angle at which the edge of the freeboard deck enters the water or the middle of the bilge comes out of the water, whichever is the less. In any case, the angle is not to exceed 15°.

3.4.6 A current velocity, at which manoeuvring of the ship without release of the tow line in the vicinity of a fixed barge is dangerous, is to be indicated in Information on Stability.

3.5 PUSHERS

3.5.1 Stability of pushers is to comply with the requirements of 3.3.

3.6 SHIPS OF DREDGING FLEET

3.6.1 Stability of ships of dredging fleet (suction dredgers, multi-bucket dredgers, etc.) is to be checked for compliance with the weather criterion (refer to 2.1) for the following load conditions:

.1 ship with full stores;

.2 ship with 10 per cent of stores.

3.7 FLOATING CRANES

3.7.1 Stability of floating cranes is to be checked for compliance with weather criterion under the most unfavourable load condition with 10 per cent of stores. The following condition is to be met:

$$M_v \leqslant M_{perm} \qquad (3.7.1)$$

where M_v = heeling moment due to wind pressure (refer to 3.7.2);
M_{perm} = maximum permissible heeling moment to be determined, having regard to the initial heel due to a load on hook in compliance with 3.7.3.

In addition to meeting the above requirement, floating slewing cranes with all possible outreaches of the boom with a load on hook are to have an angle of static heel not more than 3°.

3.7.2 When checking stability of floating cranes in working condition, i.e. with a load on hook, the heeling moment due to wind pressure is to be determined in accordance with 2.2. The design pressure for all types of cranes is assumed to be equal to 400 Pa, irrespective of the height of the windage center above the waterline.

The design windage area of continuous-walled floating crane is the area bounded by the outline of the crane; for lattice type structures — the same area with apertures between beams deducted.

The design windage area of a crane, consisting of several continuous or latticed beams of the same height located one after another, is as follows:

.1 the fore beam projected area where the beam spacing is less than the fore beam height (Fig. 3.7.2-1);

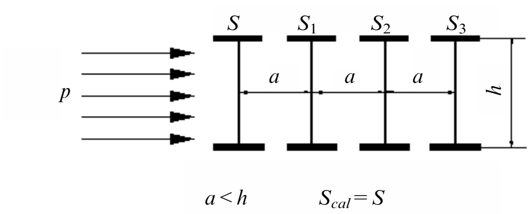


Fig. 3.7.2-1

.2 total area of the fore beam plus 50 per cent of the area of each subsequent beam where the beam spacing is equal to, or greater than the beam height but less than the double height of the beam (Fig. 3.7.2-2);

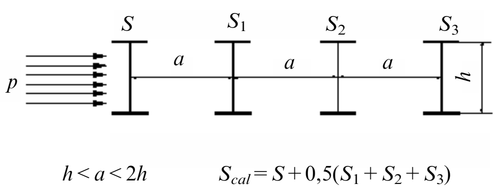


Fig. 3.7.2-2

.3 total projected area of all beams where the beam spacing is equal to, or greater than the beam double height (Fig. 3.7.2-3).

Parts of the subsequent beams not overlapped by the fore beam are to be fully taken into account.

Stability of slewing cranes is to be checked with a boom positioned perpendicular to the centerline of the ship. In such case, it is assumed that the heeling moment due to wind pressure acts in the same direction as that due to the slewed boom and a load on hook.

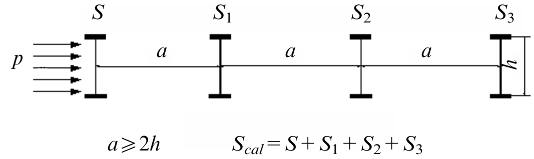


Fig. 3.7.2-3

3.7.3 Where stability of floating cranes is checked for the case of wind pressure with initial static heel due to the slewed boom with a load on hook, the maximum permissible moment M_{perm}, in kN·m, is determined by the following formula:

$$M_{perm} = 0{,}086\Delta h(\theta''_{perm} - \theta_{h1}) \qquad (3.7.3)$$

where θ''_{perm} = maximum permissible heeling angle, in deg., according to 3.1.5;
h = metacentric height, in m, with regard to free surface effect of liquids;
Δ = displacement, in kN;
θ_{h1} = angle of initial static heel, in deg., due to the slewed boom with a load on hook.

In this case, the value of θ_{perm} defined as the less value of the angles referred to in 1.2.13 and 1.2.14 is not to exceed 6°.

3.8 PASSENGER SAILING SHIPS

The proof of stability for passenger sailing ships is to be verified considering the following requirements.

3.8.1 For the calculation of the heeling moment according to 3.1.10, the furled sails are to be taken into account when determining the centre of gravity of the ship.

3.8.2 Taking into consideration all load conditions according to 3.1.1.1, and using a standard arrangement of sails, the heeling moment caused by wind pressure is not to be so high as to exceed a heeling angle of 20°. At the same time:

.1 a constant wind pressure of 0,07 kN/m^2 is to be applied for the calculation;

.2 the residual safety clearance is to be at least 100 mm;

.3 the residual freeboard is not to be negative.

3.8.3 The righting lever of static stability is to:

.1 reach its maximum value at a heeling angle of 25° or over;

.2 amount to at least 0,20 m at a heeling angle of 30° or over;

.3 be positive at a heeling angle of up to 60°.

3.8.4 The area under the righting lever curve is to be not less than 0,055 mrad up to 30°; 0,09 mrad up to 40° or at the angle at which a considered to be opened opening reaches the water surface and which is less than 40°. Additionally, between 30° and 40°, or 30° and the angle at which a considered to be opened opening reaches the water surface and which is less than 40°, this area is not to be less than 0,03 m·rad.

3.9 FLOATING EQUIPMENT

3.9.1 It is to be confirmed that, when taking into account the loads applied during operation of the working gear and whilst under way, the residual freeboard and the residual safety clearance are sufficient. For that purpose the sum of the trim and heeling angles is not to exceed 10° and the bottom of the float is not to emerge.

3.9.2 Confirmation of stability is to include the following data and documents:

.1 scale drawings of floats and working gear and the detailed data relating to these that are needed to confirm stability, such as content of the tanks, openings providing access to the inside of the ship;

.2 hydrostatic data or curves;

.3 righting lever curves;

.4 description of the operating conditions together with the corresponding data concerning weight and centre of gravity, including its unladen state and the equipment situation as regards transport;

.5 calculation of the heeling, trimming and righting moments, with a specification of the trim and heeling angles and the corresponding residual freeboard and residual safety clearances;

.6 a compilation of the results of the calculation with a specification of the limits for operation and the maximum loads.

3.9.3 Confirmation of stability is to be based on at least the following load assumptions:

.1 specific mass of the dredging products for dredgers:

sands and gravels — 1,5 t/m^3;

very wet sands — 2,0 t/m^3;

soil, on average — 1,8 t/m^3;

mixture of sand and water in the ducts — 1,3 t/m^3;

.2 for clamshell dredgers, the values given in 3.9.3.1 are to be increased by 15 per cent;

.3 for hydraulic dredgers the maximum lifting power is to be considered.

3.9.4 Confirmation of stability is to take account of the moments resulting from:

.1 load;

.2 asymmetric structure;

.3 wind pressure;

.4 turning whilst under way of self-propelled floating equipment;

.5 cross current, if necessary;

.6 ballast and provisions;

.7 deck loads and, where appropriate, cargo;

.8 free surfaces of liquids;

.9 inertia forces;

.10 other mechanical equipment.

The moments which may act simultaneously are to be added up.

3.9.5 The moment, in kNm, caused by the wind pressure is to be calculated in accordance with the following formula:

$$M_w = c_w p_w A_w (l_w + d/2) \qquad (3.9.5)$$

where c_w = shape-dependent coefficient of resistance. For frameworks c_w = 1,2; and for solid-section beams c_w = 1,6. Both values take account of gusts of wind.
The whole area encompassed by the contour line of the framework is to be taken to be the surface area exposed to the wind.
p_w = specific wind pressure; this is to uniformly be taken to be 0,25 kN/m^2;
A_w = lateral plane above the plane of maximum draught, in m^2;
l_w = distance from the centre of area of the lateral plane A_w from the plane of maximum draught, in m.

3.9.6 The moments due to turning whilst under way for floating equipment is to be determined by the Formula (3.1.11).

3.9.7 The moment resulting from current according to 3.9.4.5, is to be taken into account only for floating equipment which is anchored or moored across the current while operating.

3.9.8 The least favourable extent of tank filling from the point of view of stability is to be determined when calculating the moments resulting from liquid ballast and liquid provisions according to 3.9.4.8.

3.9.9 The moment resulting from inertia forces according to 3.9.4.9 is to be given due consideration if the movements of the load and the working gear are likely to affect stability.

3.9.10 The righting moments for floating equipment with vertical side walls may be calculated using the following formula:

$$M_R = 10 D h \sin\theta \qquad (3.9.10)$$

where h = metacentric height, in m;
θ = heeling angle, in deg.

Formula (3.9.10) is to apply to heeling angles of 10° or up to a heeling angle corresponding to immersion of the edge of the deck or emergence of the edge of the bottom; the smallest angle is to be decisive. The formula may be applied to slanting side walls up to heeling angles of 5°. If the particular shape of the float(s) does not permit such simplification the righting lever curves are to be applied.

3.9.11 If a reduced residual freeboard according to 3.9.11.7 is used, it is to be proven for all operating conditions that:

.1 after correction for the free surfaces of liquids, the metacentric height is not less than 0,15 m;

.2 for heeling angles between 0 and 30° there is a righting lever of at least

$$l = 0{,}30 - 0{,}28\theta_n \qquad (3.9.11.2)$$

where θ_n = the heeling angle from which the righting lever curve displays negative values (range of stability); it is not to be less than 20° (0,35 rad) and is not to be introduced into the formula for more than 30° (0,52 rad);

.**3** the sum of the trim and heeling angles does not exceed 10°;

.4 a residual safety clearance meeting the requirements of 3.9.10.8 remains;

.5 a residual freeboard of at least 0,05 m remains;

.6 for heeling angles between 0° and 30° a residual righting lever l_R, in m, remains at least:

$$l_R = 0{,}20 - 0{,}23\theta_n \qquad (3.9.11.6)$$

where θ_n = the heeling angle from which the righting lever curve displays negative values; it is not to be introduced into the Formula (3.9.11.6) for more than 30° (0,52 rad).

Residual righting lever l_R means the maximum difference existing between 0° and 30° of heel between the righting lever curve and the heeling lever curve. If an opening towards the inside of the ship is reached by the water at a heeling angle less than that corresponding to the maximum difference between the lever curves, the lever l_R corresponding to that heeling angle is to be taken into account;

.7 for the purpose of 3.9.11 residual freeboard means the shortest vertical distance between the water level and the upper surface of the deck at its edge taking into account trim and heel resulting from the moments referred to in 3.9.4 to 3.9.10.

The residual freeboard is sufficient according to 3.9.1, if it is at least 300 mm. The residual freeboard may be reduced provided the requirements of 3.9.11.1 to 3.9.11.6 are met;

.8 for the purpose of 3.9.11 residual safety clearance means the shortest vertical distance between the water level and the lowest point of the floating equipment beyond which it is no longer watertight, taking into account trim and heel resulting from the moments referred to in 3.9.4 to 3.9.10.

The residual safety clearance is sufficient according to 3.9.1, if any apertures which can be closed spray-proof and weathertight are at a distance of at least 300 mm. If apertures cannot be closed spray-proof and weathertight, the residual safety clearance is tp be at least 400 mm.

3.9.12 The application of 3.9.1 to 3.9.11 may be dispensed with for the following floating equipment:

.1 whose working gear can in no way alter their heeling or trim, and

.2 where any displacement of the centre of gravity can be reasonably excluded.

.3 where at maximum load the safety clearance is at least 300 mm and the freeboard at least 150 mm;

.4 where the apertures which cannot be closed spray-proof and weathertight the safety clearance is 500 mm or more.

3.10 BUOYANCY OF SHIPS LONGER THAN 110 M

3.10.1 For ships, except passenger ships, with a length of more than 110 m, which are capable of being separated in the event of an accident, it is to be demonstrated by the calculation that the separated parts of the ship remain afloat after separation, with the indication of the trim position and stability of the separate parts of the ship, as well as with indication the degree of loading above which buoyancy of the two parts is no longer ensured.

3.11 HIGH-SPEED CRAFT

3.11.1 Buoyancy, stability and subdivision characteristics of high-speed craft are to comply with the applicable requirements of Rules for the Classification and Construction of High-Speed Craft.

3.12 REQUIREMENTS TO SHIPS IN SERVICE

3.12.1 Stability characteristics of a passenger ship in service are to comply with the requirements of 3.1 not later than on the date of the first renewal survey after 1 January 2045.

3.12.2 A passenger ship in service is to be equipped with a water level alarm system in each watertight compartment not later than on the date of the first renewal survey after 1 January 2010.

3.12.3 A ship in service for which the requirements of the present Rules apply is to be equipped with a bilge water alarm in each watertight hold not later than on the date of the first renewal survey after 1 January 2010.

4 SAFETY CLEARANCE, FREEBOARD AND DRAUGHT MARKS

4.1 SAFETY CLEARANCE

4.1.1 The safety clearance is to be at least 300 mm.

4.1.2 The safety clearance in the case of ships whose openings cannot be closed by spray-proof and weather-tight devices, and for ships sailing with their holds uncovered, is to be increased in such a way that each of those openings is to be at least 500 mm from the plane of maximum draught.

4.2 FREEBOARD

4.2.1 The freeboard of ships with a continuous deck, without sheer and superstructures, is to be 150 mm.

4.2.2 The freeboard of ships with sheer and superstructures, in mm, is to be calculated using the following formula:

$$F = 150(1-\alpha) - \frac{\beta_v Se_v + \beta_a Se_a}{15} \quad (4.2.2)$$

where α = is a correction coefficient that takes account of all of the superstructures involved;
β_v = is a coefficient for correcting the effect of the forward sheer resulting from the presence of superstructures in the forward quarter of length L of the ship;
β_a = is a coefficient for correcting the effect of the aft sheer resulting from the presence of superstructures in the aft quarter of length L of the ship;
Se_v = is the effective forward sheer, in mm;
Se_α = is the effective aft sheer, in mm.

4.2.3 The coefficient is calculated using the following formula:

$$\alpha = \frac{\Sigma le_a + \Sigma le_m + \Sigma le_v}{L} \quad (4.2.3\text{-}1)$$

where le_m = is the effective length of a superstructure located in the median part corresponding to half of length L of the ship, in m;
le_v = is the effective length of a superstructure in the forward quarter of ship length L, in m;
le_a = is the effective length of a superstructure in the aft quarter of ship length L, in m.

The effective length of a superstructure is calculated using the following formulae:

$$le_m = 1(2{,}5b/B - 1{,}5)\,\frac{h}{0{,}36}; \quad (4.2.3\text{-}2)$$

$$le_v,\ le_a = 1(2{,}5b/B_1 - 1{,}5)\,\frac{h}{0{,}36} \quad (4.2.3\text{-}3)$$

where l = is the effective length of the superstructure involved, in m;
b = is the width of the superstructure involved, in m;
B_1 = is the width of the ship measured on the outside of the vertical sideplates at deck level halfway along the superstructure involved, in m;
h = is the height of the superstructure involved, in m. However, in the case of hatches, h is obtained by reducing the height of the coamings by half of the safety distance according to 4.1. In no case will a value exceeding 0,36 m be taken for h.

If b/B or b/B_1 is less than 0,6, the effective length le of the superstructure will be zero.

4.2.4 Coefficients β_v and β_a are calculated using the following formulae:

$$\beta_v = 1 - \frac{3le_v}{L}; \quad (4.2.4\text{-}1)$$

$$\beta_a = 1 - \frac{3le_a}{L}. \quad (4.2.4\text{-}2)$$

4.2.5 The effective aft/forward sheers Se_v/Se_a are calculated using the following formulae:

$$Se_v = S_v p; \quad (4.2.5\text{-}1)$$

$$Se_a = S_a p \quad (4.2.5\text{-}2)$$

where S_v = is the actual forward sheer, in mm; however S_v is not to be taken to be more than 1000 mm;
S_a = is the actual aft sheer, in mm; however S_a is not to be taken to be more than 500 mm;
p = is a coefficient calculated using the following formula:

$$p = 4X/L \quad (4.2.5\text{-}3)$$

X = is the abscissa, measured from the extremity of the point where the sheer is 0,25Sv or 0,25/Sα (refer to Fig. 4.2.5).

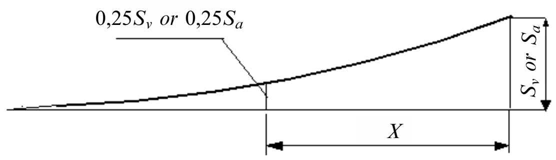


Fig. 4.2.5

However, coefficient p will not be taken to be more than 1.

4.2.6 If $\beta_a Se_a$ is greater than $\beta_v Se_v$, the value of $\beta_v Se_v$ will be taken as being the value for $\beta_a Se_a$.

4.3 MINIMUM FREEBOARD

4.3.1 In view of the reductions referred to in 4.2 the minimum freeboard is to be not less than 0 mm.

4.4 DRAUGHT MARKS

4.4.1 Subject to the provisions of the present Rules, the draught marks are surveyed and affixed by the

Register on the ships flying the flag of the Russian Federation as well as on the ships classified by the Register and flying foreign flags if the Register is authorized by the flag Administration.

4.4.2 The plane of maximum draught is to be determined in such a way that the specifications concerning minimum freeboard and minimum safety clearance are both met. However, for safety reasons, the Register may lay down a greater value for the safety clearance or freeboard.

4.4.3 The plane of maximum draught is to be indicated by means of highly visible, indelible draught marks.

4.4.4 The draught marks are to consist of a rectangle 300 mm long and 40 mm deep, the base of which is horizontal and coincides with the plane of the maximum authorized draught. Any differing draught marks are to include such a triangle.

4.4.5 Ships are to have at least three pairs of draught marks, of which one pair is to be centrally located and the two others located, respectively, at a distance from the bow and stern that is equal to roughly one-sixth of the length.

4.4.5.1 Where a ship is less than 40 m in length it will suffice to affix two pairs of marks at a distance from the bow and stern, respectively, that is equal to a quarter of the length.

4.4.5.2 Where ships are not intended for the carriage of goods, a pair of marks located roughly halfway along the ship will suffice.

4.4.6 Marks or indications which cease to be valid following a further inspection are to be deleted or marked as being no longer valid under the supervision of the Register. If a draught mark should disappear, it may only be replaced under the Register survey.

4.4.7 Where a ship has been measured in implementation of the 1966 Convention on the Measurement of Inland Navigation Vessels, those measurement marks are to take the place of the draught marks; this is to be mentioned in the Seaworthiness Certificate.

4.4.8 For ships in zones of inland waterways other than **Zone 3** (**Zones 1**, **2** and **4**) the bow and stern pairs of draught marks provided for in 4.4.5 are to be supplemented by adding a vertical line to which one or, in the case of several zones, several additional draught lines 150 mm long are be affixed towards the bow, in relation to the draught mark for **Zone 3**.

The vertical line and the horizontal line are to be 30 mm thick. In addition to the draught mark towards the bow of the ship, the relevant zone numbers are to be indicated in lettering 60 mm high × 40 mm deep (refer to Fig. 4.4.8).

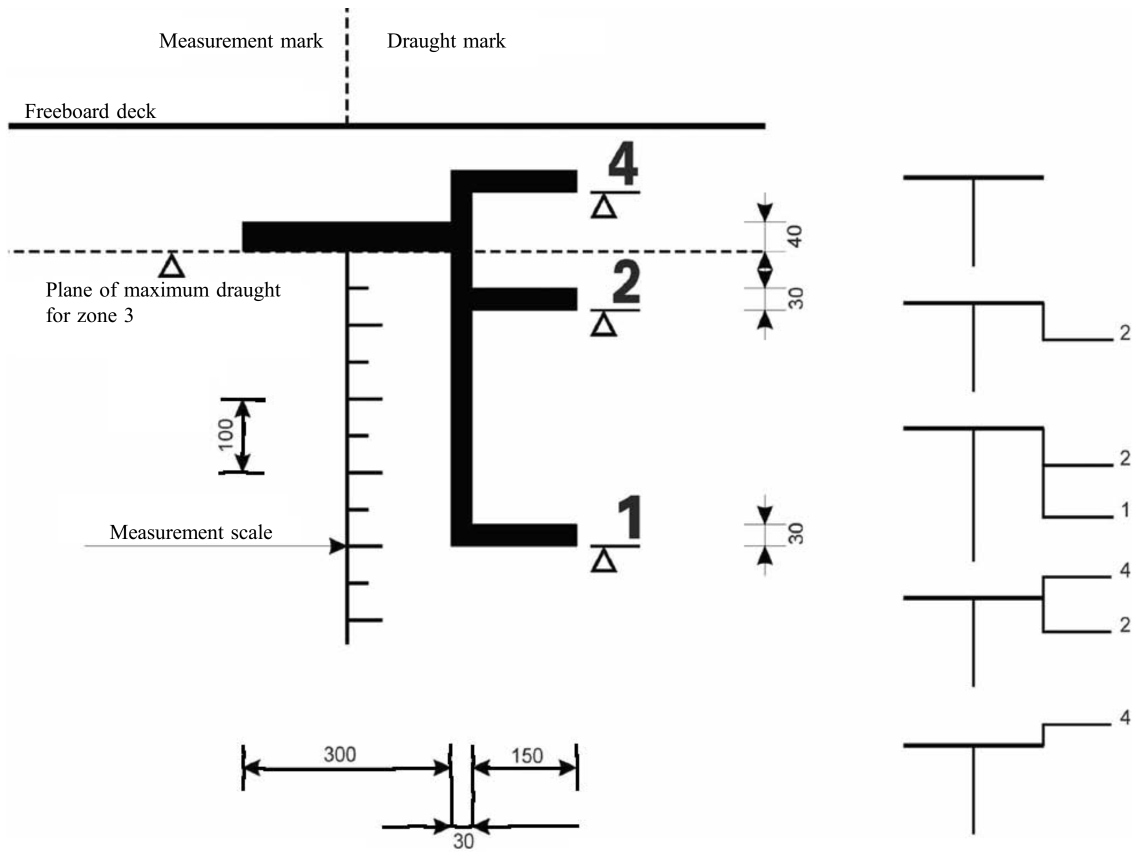


Fig. 4.4.8

4.5 MAXIMUM LOADED DRAUGHT OF SHIPS WHOSE HOLDS ARE NOT ALWAYS CLOSED SO AS TO BE SPRAY-PROOF AND WEATHERTIGHT

4.5.1 If the plane of maximum draught of a ship is determined by assuming that the holds may be closed in such a way as to make them spray-proof and weather-tight and if the distance between the plane of maximum draught and the upper edge of the coamings is less than 500 mm, the maximum draught for sailing with uncovered holds is to be determined.

The following statement is to be entered on the Seaworthiness Certificate:

«Where the hold hatches are totally or partly uncovered the ship may only be loaded up to … mm below the draught marks for **Zone 3**».

4.6 DRAUGHT SCALES

4.6.1 Ships whose draught may exceed 1 m are to bear a draught scale on each of their sides towards the stern; they may bear additional draught scales.

4.6.2 The zero points on each draught scale are to be taken vertically to this within the plane running parallel to the plane of maximum draught passing through the lowest point of the hull or of the keel where such exists. The vertical distance above the zero point is to be graduated in decimeters. That graduation is to be located on each scale, from the unladen water line up to 100 mm above the maximum draught by means of punched or chiselled marks, and is to be painted in the form of a highly-visible band in two alternating colours. That graduation is to be identified by at least five figures at a distance of every five decimeters marked next to the scale as well as at the top of the scale.

4.6.3 The two stern measurement scales affixed pursuant to the 1966 Convention on the Measurement of Inland Navigation Vessels may replace the draught scales, provided that they include a graduation that meets the requirements plus, where appropriate, figures indicating the draught.

PART V. FIRE PROTECTION

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the ship's structural fire protection, fire extinguishing systems and fire detection and alarm systems, as well as fire-fighting equipment and outfit.

1.1.2 Fire-fighting equipment, electrical equipment, machinery, systems and piping, the ship's structural components, etc. are to comply with the requirements of the present Part as well with those of the appropriate parts of the Rules.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations relating to general terminology of the Rules are given in Part I "Classification".

The following definitions have been adopted in the present Part.

Vertical fire zones are those volumes into which the hull, superstructures and deckhouses are subdivided by transverse fire-resisting and fire-retarding divisions.

Combustible medium is flammable liquids, flammable gases, compressed, liquefied or dissolved under pressure; solid combustible materials and substances, including cargoes, fuel oil, finishing materials, equipment, insulation, furniture.

Combustible materials are materials which burn or give off flammable vapours in sufficient quantity to ignite when heated to approximately 750 °C[1].

Cargo area is that part of the ship that contains cargo tanks, slop tanks and pump (compressor) rooms, cofferdams, ballast and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of ship over the above mentioned spaces; closed or semi-closed spaces through which cargo pipes run; fire hose rooms; spaces at a distance of not less than 3 m in any direction from the place where gas is discharged from ventilation and vent pipes of cargo holds.

Flammable liquids are liquids or mixtures of liquids, or liquids containing solids in solution or suspension (paints, varnishes, lacquers etc.) which give off flammable vapours at or below 60 °C closed cup test.

Accommodation spaces are crew and passenger cabins, lounges, offices, sanitary spaces, barber's and hairdresser's, single rooms for servicing, corridors, lobbies and companionways adjacent thereto.

Structural fire protection is a complex of passive means of structural fire protection aimed at:

prevention of fire hazard;

containment of fire and smoke spread throughout a ship;

provision for safe evacuation of people from the ship's spaces and from the ship;

extinction of fire.

Protected zone is a space over the deck limited:

vertically — by a horizontal plane located at a height of 3 m above the deck;

longitudinally — by vertical planes passing at a distance of 5 m from cargo to be protected;

transversely — by vertical planes being continuation of the ship's hull shell.

Material equivalent to steel is a non-combustible material which, due to itself or insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable fire exposure during a standard fire test.

Materials having ignition and surface flame spread resistance characteristics are non-combustible or combustible materials resistant to ignition or flame spread over a surface[1].

Muster areas are areas of the ship which are specially protected and in which passengers muster in the event of danger.

Non-combustible materials are materials which neither burn nor give off flammable vapours in sufficient quantity to ignite when heated to approximately 750 °C[1].

Fire-retarding or "B" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which are to comply with the following requirements:

.1 be fully constructed of non-combustible materials.

The use may be allowed of combustible veneers having low flame spread characteristics and in the volume not more than that taken by veneers 2,5 mm thick over the entire surface of bulkheads and ceilings;

.2 be so constructed as to be capable of preventing the passage of flame during 30 min of the standard fire test;

[1] Combustibility, flammability and flame spread characteristics are to be determined in accordance with the procedures approved by the Register.

.3 have insulation value such that the average temperature of the unexposed side does not rise more than 140 °C above the original temperature nor does the temperature at any point, including any joint, rise more than 225 °C above the original temperature when either side is exposed to flame. Depending on the time during which the above temperature difference is maintained in the course of the standard fire test the divisions are classified as follows: class "B-15" — 15 min; class "B-0" — 0 min.

Fire-resisting or "A" class divisions are those divisions formed by bulkheads and decks which are to comply with the following requirements:

.1 be constructed of steel or other equivalent material;

.2 be suitably stiffened;

.3 be so constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test;

.4 ensure that the average temperature of the unexposed side does not rise more than 140 °C above the original temperature, nor does the temperature, at any point, including any joint, rise more than 180 °C above the original temperature, within 60, 30, 15, 0 min, depending on which the divisions are classified as "A-60", "A-30", "A-15", "A-0", respectively.

Protected space is a space equipped with one of fire extinguishing systems or with an automatic fire detection and alarm system.

Adjacent spaces are those spaces which are separated from one another by a bulkhead, deck, any other fixed division without openings or with permanently closed openings. Spaces and compartments contacting to each other by corners are not considered as adjacent spaces.

Spaces separated from one another by removable divisions or having openings not fitted with means of closing in the bulkhead or deck that separates them are considered as one single space.

Fire control station is a space where starting controls of fire extinguishing systems, items of fire fighting outfit or fire alarms are arranged.

Main fire control station is a room or part thereof, where fire detection and alarm units and remote starting controls of fire extinguishing systems (if any) are centralized, located on the bridge or in other control stations having direct communication with the bridge and 24 h watch when the ship is under way.

Control stations are spaces where main navigational instruments and the ship's steering equipment, radio stations and public address stations, main fire control stations, fire extinction stations, accumulator batteries and generator rooms for radio stations or emergency lighting as well as rooms containing emergency sources of electrical power.

Lounges are rooms of accommodation or passenger areas with a deck area of 50 m^2 and more.

Fixed fire extinquishing systems are systems intended for supply of a fire extinguishing medium to the protected spaces or directly therein and structurally fixed to the ship's hull.

Fire-fighting outfit is portable fire-fighting equipment (apparatus, appliances, consumables) intended for fire extinction as well as for ensuring effective fire-fighting actions of the crew and operation of fire extinquishing systems.

A standard fire test is a test in which a specimen of a bulkhead or deck, having a heating surface of at least 4,65 m^2 resembling as closely as possible the intended construction is exposed to a heating in a test furnace to the following temperatures counting from the original temperature:

At the end of the first	5 min	556 °C;
	10 min	659 °C;
	15 min	718 °C;
	30 min	821 °C;
	60 min	925 °C.

Flash point is the lowest temperature at which vapours of a flammable liquid form with the ambient air a mixture capable of igniting at an open flame. The flash point of flammable liquids is to be determined in a closed cup by means of an approved apparatus.

Hardly flammable material is a material which in the process of testing does not give off combustible gas in a sufficient quantity to sustain flame longer than 10 s.

Smothering is filling of a protected space with a medium not supporting combustion.

Surface extinction is cooling or wetting of burning surfaces or restriction of oxygen access thereto.

Domestic service spaces are galleys, public spaces, ship workshops and similar spaces containing solid-fuel-, oil- or gas-fired, or electric equipment, provision stores, storerooms for various supplies and corridors adjacent thereto.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General regulations for the classification, technical supervision of ships under construction and classification surveys as well as the scope of documentation to be submitted to the Register for review and approval are given in General Regulations for the Classification and Other Activity and in Part I "Classification".

1.3.2 Subject to the Register technical supervision are: structural fire protection; materials used for insulation and interior finishing of the ship's spaces as regards their fire hazardous properties; fire extinguishing, fire detection and alarm systems, liquefied gas systems as well as fire-fighting outfit within the scope of the requirements of the present Part.

1.3.3 To be submitted to the Register for approval of newly applied active fire-fighting means and passive means of structural fire protection are Type Approval Certificates issued by competent organizations recognized by the Administration, test records and other technical documentation confirming the fulfillment of the requirements of the present Part.

1.4 DRAWINGS AND PLANS

1.4.1 On each self-propelled ship of 25 m in length and over, at the main fire control station or in a wheelhouse and in conspicuous positions in corridors and lobbies, there are to be exhibited, in accordance with the present Part of the Rules, general arrangement plans clearly showing the following for each deck:

.1 arrangement of control stations;

.2 arrangement of protected spaces;

.3 arrangement of fire-retarding and fire-resisting divisions, including doors;

.4 arrangement of fire hydrants;

.5 arrangement of fire-fighting outfit;

.6 arrangement of fire detectors;

.7 means of access to different compartments, decks, etc. with indication of escape routes, corridors and doors;

.8 on passenger ships — diagram of the ventilation system showing the position of dampers and fans serving each zone.

1.4.2 Information on plans is to be given in the national language and in English, the symbols used for items are to comply with international standards accepted by the Administration.

1.4.3 All alterations in the ship's fire protection are to be immediately entered in the documents referred to in 1.4.1.

2 STRUCTURAL FIRE PROTECTION

2.1 GENERAL

2.1.1 The requirements of 2.3 to 2.5 of the present Part are general requirements relating to structural fire protection if inland navigation ships.

Additional requirements for particular types of ships are given in 2.6 to 2.8.

2.2 REQUIREMENTS FOR MATERIALS

2.2.1 Materials used for manufacture of components and constructions in engine and boiler rooms are to be non-combustible.

2.2.2 Insulation of the ship's spaces is to be:

.1 made of non-combustible materials for sides, decks, bulkheads, enclosures and other constructions. In sound cases combustible materials with low flame spread characteristics may be used;

.2 heat and noise insulation of sides, bulkheads, decks and casings is to be made of non-combustible materials in engine and boiler rooms. The surface of any insulation in those rooms is to be impervious to fuel oil, lubricating oil and their vapours.

2.2.3 In control stations, accommodation and domestic service spaces including corridors leading thereto and stairway enclosures, permanent deck coverings of 5 mm and more in thickness are to be hardly flammable. Outer surfaces of bulkheads and ceilings as well as surfaces in concealed and inaccessible spaces (behind panellings, linings, etc.) in those spaces are to be made of materials with low flame spread characteristics. In case of fire, the above materials are not to give off toxic and explosive vapours.

2.2.4 Insulation of passages and stairways used as escape routes is to be non-combustible. Linings of bulkheads and decks in those places are to have low flame spread characteristics.

2.2.5 Veneers and linings of outer surfaces in accommodation and domestic service spaces as well as veneers used for furniture may be made of combustible materials not more than 2 mm in thickness, provided the above spaces are not adjacent to machinery spaces. The above rating may be increased on agreement with the Register, provided materials with low flame spread characteristics are used.

2.2.6 The amount of combustible materials used for construction of interior bulkheads, grounds, insulation, linings, finishes, furniture and other equipment of control stations, accommodation and domestic service where the use of such materials is not prohibited by the present Part of the Rules is not to be in excess of 45 kg per 1 m^2 of the deck area of those spaces. Depending on the type and purpose of the ship the Register may revise the above rating.

2.2.7 Varnishes, paints and similar finishing materials having a nitro-cellulose or other highly flammable base are not to be used for interior finishing of the ship. The above coatings are not to give off excessive amount of smoke and toxic substances, which is to be determined according to the procedure accepted by the Administration.

2.2.8 Materials capable of resisting the flame spread are to be used for fabrication of carpets and other coverings, curtains, draperies, furniture covers and furnishings.

It is recommended not to use highly flammable bedding on ships provided with cabins.

2.2.9 All waste receptacles are to be made of non-combustible materials with no openings in sides and bottoms.

2.3 BULKHEADS, PASSAGES, DOORS, STAIRWAYS. DRAUGHT STOPS

2.3.1 Structural bulkheads and decks separating control stations, engine and boiler rooms and their casings, galleys from adjacent spaces are to be made of steel or another equivalent material.

2.3.2 Where aluminium alloys or wood are used for construction of superstructures and deckhouses, the requirement of 2.3.1 is to be met.

2.3.3 Exits from the spaces, stairways, doors and escape hatches are to be in compliance with the requirements of Part III "Arrangements, Equipment and Outfit" of Rules for the Classification and Construction of Sea-Going Ships.

2.3.4 Two exits one of which may be an emergency exit are to be provided from each engine and boiler room with area more than 35 m^2, as well as from propeller shaft tunnels. The exits are to be spaced as far apart as possible and be fitted with steel rigidly fixed stairways leading to the open deck or corridor that communicates with the open deck. Living and sleeping quarters are to have at least two exits, except areas with an exit giving directly onto the deck or into a corridor which serves as an escape route, provided the corridor has two exits at a distance from each other and giving onto port and starboard.

Emergency exits which may include skylights and windows, are to have a clear opening of at least 0,36 m^2 with a smallest side of at least 0,5 m and it is to be possible to open them from the inside.

2.3.5 The position of stairways and vertical ladders in the spaces intended for the crew and in other spaces where the crew normally works is to provide a quick exit to the open deck.

2.3.6 All interior and outside stairways are to be made of non-combustible materials. The interior stairways and enclosing structures located below the open deck are to be made of steel or another equivalent material.

2.3.7 Lift and hoist trunks are to be formed by fire-resisting divisions capable of preventing passage of smoke and flame from one between deck to another.

2.3.8 In the vertical direction air spaces behind linings of stairways, trunks, etc. as well as openings in decks for passage of pipes and cables are to be closed at each deck by a non-combustible material.

2.4 STOREROOMS CONTAINING FLAMMABLE MATERIALS

2.4.1 Storerooms containing flammable materials and explosives are generally not to be arranged within the same superstructure or deckhouse where accommodation spaces are located. In special cases, upon agreement with the Register, such arrangement may be allowed, provided they are not adjacent to accommodation and machinery spaces, fuel oil and lubricating oil tanks.

2.4.2 Bulkheads and decks of storerooms are to be made of steel or another equivalent material.

Where material other than steel is used for construction of the hull, superstructures and deckhouses, bulkheads and decks of at least "B-15" class are to be used in storerooms.

2.4.3 Storerooms containing flammable materials and explosives are to meet the following requirements:

.1 storerooms are to have separate exits to the open deck or corridor or companionway that directly communicates with the open deck;

.2 equipment of storerooms is to be of non-combustible materials;

.3 natural supply and exhaust ventilation is to be provided in storerooms. Outlets of ventilation pipes are to be equipped with flame-arresters;

.4 flammable liquids being part of the ship's supplies and having a flash point below 43 °C are to be kept in storerooms in special metal tanks with air pipes led outside and equipped with flame-arresters;

.5 the total capacity of the tanks containing flammable liquids on board is not to exceed 150 l;

.6 doors of storerooms are to open to the open deck and bear an inscription "Flammable!".

2.4.4 Where a separate storeroom containing flammable liquids cannot be arranged, they may be stored in steel lockers or cases complying with the following requirements:

.1 lockers or cases are to be provided with tight-closing doors or lids with locks and ventilation pipes equipped with flame-arresters;

.2 lockers or cases are not to be contiguous to accommodation spaces;

.3 doors or lids where they contact the locker housing are to be lined with materials preventing spark formation;

.4 where lockers or cases made of combustible materials are arranged on the deck, the latter is to be provided with insulation of a steel sheet on an asbestos layer at least 5 mm thick on the area corresponding to the case or locker size. Instead of insulation, lockers or cases may be installed on the supports of at least 50 mm high;

.5 inside lockers or cases flammable liquids may be kept in tightly closed cans;

.6 steel cans are to be secured in sockets lined with a non-combustible material preventing spark formation;

.7 capacities of individual cans for flammable liquids are to be no more than 20 l. The total capacity of the cans for flammable liquids allowed to be kept on board the ship is not to exceed 40 l;

.8 use of cans made of synthetic materials is not allowed;

.9 on the outside of the lockers or cases the warning notice is to be provided: "Flammable! No smoking!".

2.4.5 Consumable rags may be kept in machinery spaces in separate steel closable cases without openings. Used rags are to be kept in storerooms outside machinery spaces.

2.5 SPACES FOR ELECTRIC WELDING OPERATIONS AND FOR STORAGE OF CYLINDERS

2.5.1 Spaces for storage of oxygen and acetylene cylinders are to be located at a distance not less than 2 m from accommodation spaces and control stations and not less than 4 m from the spaces where readily flammable substances and fuel oil are kept or where essential ship's equipment is installed.

2.5.2 A space for storage of acetylene cylinders is to be independent of that for oxygen cylinders.

2.5.3 Spaces for storage of cylinders are to be separated from the adjacent spaces by "A-60" class divisions and to have an entrance directly from the open deck.

2.5.4 Doors of the spaces are to open outside, be provided with locks and warning notices.

2.5.5 Places for storage of oxygen and acetylene cylinders are to be equipped, considering the following requirements:

.1 oxygen and acetylene cylinders are to be stored on open decks in vertical position in special closed spaces provided with natural ventilation;

.2 places where cylinders are stored are to be fitted with stands having sockets, straps or other arrangements to ensure efficient securing and quick release of cylinders;

.3 places for storage of cylinders on the open deck are to be equipped so as to preclude occasional mechanical damage to cylinders and access of unauthorized persons;

.4 cylinders are to be protected against direct sunrays;

.5 on the barrier around the cylinder storage area there are to be provided warning notices: "Danger of explosion!" and "No smoking!";

.6 cylinders are not to be fastened to the bulkheads of accommodation spaces;

.7 no other equipment is to be arranged in the spaces for storage of cylinders, no cables or pipes are to be routed through those spaces;

.8 cylinders are not to be kept in the spaces for electric welding operations.

2.5.6 Spaces for electric welding operations on ships are to be arranged, having regard to the following:

.1 spaces are to be separated from adjacent spaces by "A-60" class divisions and be equipped with artificial ventilation;

.2 they are to have an exit to the open deck;

.3 the door is to be fitted with a lock.

2.6 PASSENGER SHIPS

2.6.1 The requirements of the present Chapter are additional to those of 2.1 to 2.5. The suitability for fire protection of materials and structures used on board passenger ships is to be established in accordance with the Fire Test Procedures Code (Resolution MSC.61(67)).

2.6.2 On passenger ships provided with sleeping berths, the hull, superstructures and deckhouses are to be divided by fire-resisting bulkheads into main vertical zones, considering the following requirements:

.1 bulkheads are to extend from side to side throughout the breadth of the hull, superstructure and deck and, vertically, from the bottom to the upper deck of the passenger superstructure or deckhouse;

.2 the bulkhead may be stepped, the class of the divisions used in the stepped portion being not lower than that of the main division;

.3 a distance between the bulkheads (the length of each zone) is not to exceed 40 m or the deck area between the bulkheads is not to exceed 800 m^2;

.4 on passenger ships of 65 m in length and over, the class of divisions separating fire zones is not to be lower than "A-30". On agreement with the Register, depending on the structural features of the ship, amount of combustible materials and active fire fighting means available, the use of other divisions may be allowed but not lower than of "B-15" class.

2.6.3 Cabins are to be separated from each other and from the corridors connecting them by fire-retarding bulkheads and doors. Where cabins are provided with a sprinkler system, the above requirement is not mandatory.

2.6.4 Partitions between rooms inside the hull and superstructures are to be designed in accordance with Tables 2.6.4-1 and 2.6.4-2.

2.6.5 Doors in fire-resisting bulkheads referred to in 2.6.2 are to be of a self-closing type and to be of the same class as the bulkhead in which they are fitted.

The door is to be provided with an "open — closed" position indicator.

2.6.6 Provision is to be made for fire-retarding self-closing doors kept open under normal operating conditions for closing then from the permanently manned main control station and locally from either side of the bulkhead in which the door is fitted.

Table 2.6.4-1

For ships not fitted with pressurized sprinkler systems according to 4.6

Rooms	Control centres	Stairwells	Muster areas	Lounges	Engine rooms	Galleys	Storerooms
Control centres	—	A-0	A-0/B-15[1]	A-30	A-60	A-60	A-60
Stairwells	—	—	A-0	A-30	A-60	A-60	A-60
Muster areas	—	—	—	A-30/B-15[1]	A-60	A-60	A-60
Lounges	—	—	—	B-15	A-60	A-60	A-60
Engine rooms	—	—	—	—	A-60/A-0[3]	A-60	A-60
Galleys	—	—	—	—	—	A-0	A-60/B-15[4]
Storerooms	—	—	—	—	—	—	—

[1] for internal muster areas /for external muster areas.
[2] "B-0" — for rooms fitted with pressurized sprinkler systems; "B-15" — for partitions between rooms not fitted with pressurized sprinkler systems and bulkheads separating main vertical zones according to 2.6.2.
[3] "A-60" — for partitions between rooms housing the second independent propulsion system or an emergency diesel generator; "A-0" — for other cases.
[4] "B-15" — for partitions between galleys and cold-storage rooms; "A-60" — for other cases.

Table 2.6.4-2

For ships fitted with pressurized sprinkler systems according to 4.6

Rooms	Control centres	Stairwells	Muster areas	Lounges	Engine rooms	Galleys	Storerooms
Control centres	—	A-0	A-0/B-15[1]	A-0	A-60	A-60	A-30
Stairwells	—	—	A-0	A-0	A-60	A-30	A-0
Muster areas	—	—	—	A-30/B-15[1]	A-60	A-60	A-60
Lounges	—	—	—	B-0/B-15[2]	A-60	A-30	A-0
Engine rooms	—	—	—	—	A-60/A-0[3]	A-60	A-60
Galleys	—	—	—	—	—	—	B-15
Storerooms	—	—	—	—	—	—	—

[1] for internal muster areas /for external muster areas.
[2] "B-0" — for rooms fitted with pressurized sprinkler systems; "B-15" — for partitions between rooms not fitted with pressurized sprinkler systems and bulkheads separating main vertical zones according to 2.6.2.
[3] "A-60" — for partitions between rooms housing the second independent propulsion system or an emergency diesel generator; "A-0" — for other cases.
[4] "B-15" — for partitions between galleys and cold-storage rooms; "A-60" — for other cases.

2.6.7 Other openings in fire-retarding bulkheads are to be closed with a non-combustible material and sealed so that fire resistance of the bulkhead is not impaired.

2.6.8 Stairways including stairs are to have frame construction of steel or other equivalent material. Stairs are to be of hardly flammable material.

2.6.9 Internal stairs and lifts connecting only two decks may be encapsulated at only one level by walls according to 2.6.4.

In a lounge, stairs need not be encapsulated if they are located entirely within the interior of this room, and:

.1 if this room extends over only two decks, or

.2 if there is a pressurized sprinkler system according to 4.6 installed in this room on all decks, this room has a smoke extraction system and the room has access on all decks to a stairwell.

2.6.10 Stairways, which penetrate more than one deck and have at least two exits to the open deck at every accommodation level, may be protected by "B-0" class fire-retarding divisions.

2.6.11 Where a space is protected by an automatic sprinkler system, service stairways, which are used only for connection of decks and for which there is no requirement to have an exit to the open deck, need not be enclosed.

2.6.12 Materials having high flame spread characteristics are not to be used for manufacture of grounds, plating of interior decks, linings and insulation of the ship's sides, bulkheads and ceilings, as well as of furniture. Where the use of wood (other than the wood used for facing and manufacture of the equipment of galleys and provision stores, saunas and furniture made of hard wood) is unavoidable in the above cases, it is to be subjected to fire-protective impregnation.

2.6.13 Air spaces enclosed behind ceilings, panellings or linings are to be suitably divided by close-fitting draught stops and spaced not more than 10 m apart.

2.6.14 Paints, lacquers and other surface-treatment products as deck coverings used in rooms except engine rooms and store rooms are to have low flame spread characteristics.

Carpets, fabrics, curtains and other hanging textile materials as well as upholstered furniture and components of bedding in cabins and public spaces are to be resistant to ignitability and flame spread.

The above materials are not to produce excessive quantities of smoke or toxic products.

If the rooms have a pressurized sprinkler system the requirements of the present paragraph are not mandatory, which is subject to special consideration by the Register.

2.6.15 In the lounges and muster areas not fitted with a pressurized sprinkler system in accordance with 4.6, ceilings and wall linings, including their substructures, as well as furniture, are to be manufactured from non-combustible materials.

2.7 OIL TANKERS

2.7.1 The requirements of the present Chapter are additional to those of 2.1 to 2.5.

2.7.2 Side scuttles and windows in exterior boundaries of superstructures and deckhouses facing the cargo area as well in adjacent side structures at a distance of 3 m are to be of fixed (non-opening) type. Doors are not to be fitted in the above areas.

This requirement is not applicable to the cargo operations control stations which do not directly communicate with accommodation and service spaces, and to the wheelhouse.

2.7.3 Cargo oil tanks are to be separated from machinery spaces by cofferdams.

The length of cofferdams is to be equal to a spacing but not less than 0,5 m. Bypass slide valves in cofferdam bulkheads are not allowed.

Where a pump room is adjacent to the engine room a cofferdam is not required.

2.7.4 A permanent continuous coaming extending from side to side of the ship of not less than 150 mm high is to be fitted on the upper deck at a distance of about 2 m from the superstructure where accommodation and domestic service spaces are located.

2.7.5 Pump rooms are to be separated from machinery spaces and cofferdams by gastight bulkheads. Separate tightly closed exits to the open deck are to be provided from the spaces.

Pump rooms are not to directly communicate with the machinery spaces.

2.7.6 Pump rooms and cargo pumps installed therein are to be equipped with devices for collection and removal of cargo spills.

2.7.7 Accommodation spaces are to be located in aft superstructures made of steel or other equivalent material.

2.7.8 Accommodation spaces are to have two exits to the superstructure deck arranged in the opposite side bulkheads of the superstructure. In separate cases, on agreement with the Register, one of the exits may be arranged in the aft part of the superstructure deck.

2.7.9 The galley is to be located in the aft part of the superstructure or deckhouse behind the accommodation spaces.

2.7.10 Where cargo is to be heated, oil-fired boilers using fuel oil with a flash point above 55 °C may be installed in the machinery space or a special compartment with an access thereto from the deck or the machinery space.

2.7.11 Use of coal and fuel oil with a flash point below 60 °C is not allowed for engines and heating boilers, galley ranges or other similar equipment.

2.7.12 A smoking room is to be provided in the superstructure of oil tankers meeting the following requirements:

.1 equipment and linings are to be of non-combustible materials;

.2 an exit to the corridor is to be provided;

.3 side scuttles are to be of the fixed (non-opening) type;

.4 the room is to be fitted with exhaust ventilation.

2.7.13 In cargo oil tanks, cofferdams, pump rooms, in the cargo area and other places where accumulation of explosive vapours is possible, the use of wood, aluminium paints and other combustible materials is not allowed.

2.7.14 The electric welding room is to comply with the requirements of 2.5.6 and also with the following requirements:

.1 it is to be located aft of cargo tanks, slop tanks and cofferdams bounding them;

.2 it is neither to be located within machinery spaces of category A nor at a distance less than 5 m from the spaces intended for storage and carriage of explosion- and fire-hazardous materials;

.3 a distance from the room to gas vents of cargo and slop tanks is to be not less than 9 m;

.4 it is to be fitted with mechanical ventilation capable to ensure at least 20 air changes per hour;

.5 a source of the welding current is to have interlocks capable of precluding its switching on when the entrance door is open and mechanical ventilation is not in operation;

.6 a light notice “Entrance forbidden! Welding!” is to be placed next to the entrance door.

2.7.15 Cargo manholes and inspection hatches are not to lead to closed or semi-closed spaces.

2.7.16 Inspection hatches are to be fitted with a double layer of flame-arresting gauze.

2.8 OIL TANKERS (> 60 °C)

2.8.1 The requirements of the present Chapter are additional to those of 2.1 to 2.5.

2.8.2 Cargo tanks are not to be adjacent to accommodation spaces.

2.8.3 No doors leading to accommodation spaces are to be arranged in the front bulkhead of superstructures and deckhouses.

2.8.4 A permanent continuous coaming extending from side to side of the ship of not less than 150 mm high is to be fitted on the upper deck at a distance of about 2 m from the superstructure where accommodation and domestic service spaces are located.

2.8.5 Machinery spaces are to be located in the aft part of the ship outside the cargo area.

3 FIRE SAFETY REQUIREMENTS FOR DOMESTIC AND SHIP EQUIPMENT AND SYSTEMS

3.1 EQUIPMENT OF GALLEYS

3.1.1 Galleys are not to be located in spaces adjacent to storerooms for storage of readily flammable and combustible materials and to spaces for storage of fuel oil and lubricating oil, except for supply units where receptacles of liquefied gas installations for domestic purposes are arranged.

3.1.2 Bulkheads and decks of galleys are to be of a fire-resisting material.

3.1.3 Constructions made of combustible materials surrounding galley ranges are to be covered with heat insulation of a non-combustible material, sheathed with steel sheets, which are to project beyond the range for at least 500 mm.

3.1.4 At least two exits are to be provided from every galley serving more than 50 persons other than galleys using electricity or steam, which may have only one exit.

3.1.5 Galley ranges may be electrical or gas, they may also use fuel oil or solid fuel. A flash point of vapours of fuel oil used for galleys is not to be below 60 °C.

Galley ranges using fuel oil or solid fuel are to be provided with a metal casing lined with refractory bricks and a soot-cleaning device.

3.1.6 Trays for collection of fuel oil leakage with walls of at least 75 mm high, which project beyond the burner for not less than 100 mm are to be placed under burners of oil-fired ranges.

3.1.7 Daily fuel oil tanks and oil fuel pipelines are to be equipped in accordance with the requirements of Part VII "Systems and Piping".

3.1.8 Daily fuel oil tanks are not to be installed in galleys. On agreement with the Register, a daily fuel oil tank may be installed in the galley as far remote from the range and doors as possible but not less than 1 m.

The fuel oil tank is not to be arranged above the range.

The capacity of the daily tank installed in the galley is not to exceed a daily requirement but is not to be more than 50 l.

3.1.9 A shut-off valve on the service pipe is to be, in addition to local control, remote controlled from permanently accessible location outside the galley.

3.1.10 Galley range stacks running inside the ship's spaces are to be covered with a non-combustible heat insulation of such thickness that the outside surface of the insulation is not heated above 60 °C.

3.2 HEATING

3.2.1 Equipment using solid-, oil- or gas-fuel, or electricity may be used for heating of the ship's spaces.

3.2.2 On agreement with the Register, the use of solid fuel-fired equipment for central heating of the ship's spaces may be allowed on ships not carrying highly flammable liquids.

3.2.3 The use of solid fuel-fired local furnaces is not allowed on passenger ships and on oil tankers, on tugs and pushers serving oil tankers as well on ships intended for the carriage of highly flammable cargoes.

In sound cases, the use of furnace heating of the ship's spaces may be allowed on oil barges.

3.2.4 All radiators are to be so constructed and installed as to reduce fire risks to a minimum.

3.2.5 Radiators are to be protected with housings. A temperature on the housing surface is not to exceed 60 °C.

3.2.6 Electrical heating is to comply with the requirements of 15.2, Part IX "Electrical Equipment".

3.2.7 Where steam heating pipes penetrate wooden bulkheads or bulkheads lined with combustible material, draught-stops projecting for 50 mm on each side and covered with steel sheets on an asbestos layer 2 mm thick.

For water heating pipes a fire stop is to project for at least 25 mm on each side. No asbestos insulation is required in this case.

3.2.8 When installing and arranging radiators and furnaces, the following requirements are to be met.

3.2.8.1 No heating equipment using solid fuel may be installed in spaces containing cans with fuel oil or oil-fired equipment.

3.2.8.2 Metal heating furnaces without brick lining or water jacket are not to be installed in the ship's spaces.

3.2.8.3 Water radiators are to be so installed that a distance from radiator fins to combustible constructions is not less than 25 mm.

3.2.8.4 Steam radiators and electric heating appliances are to be installed at a distance not less than 50 mm from the ship's sides and bulkheads.

3.2.8.5 Parts of the ship's side or bulkhead lined with wood, veneer or other combustible material and located opposite to heating appliances are to be protected with heat insulation of a non-combustible material. Where there is no such insulation, heating appliances are to be at a distance of at least 150 mm from combustible linings.

3.2.8.6 Electric heating appliances are to be placed in the direction of heat radiation at a distance of not less than 1 m from combustible constructions.

3.2.8.7 Heating furnaces are to be placed at a distance of not less than 500 mm from combustible constructions. Where such constructions have heat insulation of non-combustible material the distance is to be at least 250 mm. It may be reduced if the air can freely circulate between the combustible construction and its heat insulation.

In the case where the parts of constructions next to furnaces are totally made of non-combustible materials, the minimum distance is not regulated.

3.2.8.8 The distance from the furnace door to a combustible bulkhead is to be at least 1,25 m. Where the bulkhead is made of a non-combustible material or is insulated with steel sheets on an asbestos layer of 5 mm thick, the distance may be reduced to 1 m.

3.2.8.9 Steel plates are to be fitted in front of furnace doors and an ash holes.

3.2.8.10 Furnaces are to be reliably secured to prevent them from shifting in case of the ship's motions.

3.2.8.11 Auxiliary and heating boilers are to be arranged so that, even in case of their overheating, no hazard arises for other equipment. They are not to be installed close to fuel oil and lubricating oil tanks as well as to hold bulkheads.

3.2.8.12 On oil tankers intended for the carriage of petroleum products with a flash point above 55 °C, heating appliances using fuel oil with a flash point above 55 °C may be installed in the wheelhouse located beyond the cargo area.

3.3 LIQUEFIED GAS INSTALLATIONS FOR DOMESTIC PURPOSES

3.3.1 General.

3.3.1.1 The requirements of the present Chapter apply to fixed installations generally consisting of one or more gas receptacles, one or more pressure reducers, distribution system and gas-consuming appliances.

3.3.1.2 On ships installations of an approved type meeting the requirements of Part VII "Systems and Piping" and made in accordance with the requirements of the Administration, are to be used.

The installations, which are not fixed, may be used only in case of compliance with special requirements of the Administration.

3.3.1.3 It is allowed to use on ships carbon liquefied gas meeting the requirements of national standards in force.

3.3.1.4 Liquefied gas installations may be used in accommodation spaces and in the wheelhouse for domestic purposes only, such as food preparation and in water heaters requiring not more than 1,5 kg of liquefied gas per hour.

The use of liquefied gas for other purposes is subject to special consideration by the Register.

3.3.1.5 Domestic liquefied gas installations may be installed on all ships other than small ships with petrol engines intended for the carriage of passengers.

The use of liquefied gas installations on oil tankers is subject to special consideration by the Register in each particular case.

3.3.1.6 Components of liquefied gas installations are not allowed to be placed in the machinery space.

3.3.1.7 On oil tankers covered by Rules for the Carriage of Dangerous Goods by Inland Waterways, components of liquefied gas installations are not allowed to be placed within the cargo tank area.

3.3.1.8 Several separate liquefied gas installations may be fitted on the ship.

Accomodation areas separated by a cargo hold or a fixed tank are not to be supplied by the same installation.

3.3.1.9 Openings in the deck located at a distance of less than 3 m from doors or other types of closures of spaces where components of liquefied gas installations are located are to be provided with coamings of at least 150 mm high.

3.3.1.10 All the equipment of the ship's liquefied gas installations for domestic purposes, including gas pipes, is to be reliably secured.

3.3.2 Receptacles.

Only receptacles with a capacity of between 5 and 35 kg complying with national standards are allowed for installation on board ships.

In special cases, the Register may allow use of receptacles with a greater capacity.

3.3.3 Supply unit.

3.3.3.1 The supply unit is to be arranged on the open deck in a special cupboard or a recess of the superstructure or deckhouse provided it is gastight in relation thereto and has only outside openings.

3.3.3.2 The unit is to be so located on the deck as to ensure the minimum length of distribution pipes to gas consumption points and to provide free passage for people on the deck.

3.3.3.3 The construction of the supply unit is to comply with the requirements of 2.4.1 and, additionally, with the following requirements:

.1 a direct access to the deck is to be provided;

.2 structural arrangements are to be provided, where necessary, to prevent a temperature inside the space from exceeding 50 °C;

.3 where necessary, structural arrangements are to be provided to prevent a temperature of the receptacles located in the unit from exceeding 40 °C;

.4 no artificial lighting is to be provided; in exceptional cases, where lighting is required, it is to be electrical with lamps of a certified safe type, a switch being placed from the outside of the unit;

.5 in case of gas leakage, no hazard is to arise of gas penetration into interior spaces of the ship or gas contact with likely sources of ignition. Where necessary, a special vent pipe is to be fitted for that purpose;

.6 a notice or symbol prescribed by the Administration is to be displayed on the door with a warning of an explosion hazard and prohibition of using a naked lights or fires and smoking;

.7 a powder or carbon dioxide fire extinguisher is to be installed at the entrance to the supply unit;

.8 liquefied gas receptacles are to be installed vertically with the valves up in special sockets made of materials capable of preventing spark formation and are to be secured to the walls of the supply unit with quick-release arrangements;

.9 equipment not directly related to the supply unit is not allowed to be arranged therein.

3.3.3.4 A cupboard for storage of receptacles, in addition to the requirements referred to in 3.3.3.1 and 3.3.3.2, is to meet the following requirements:

.1 the cupboard is not to be placed at the plating of the fore or aft bulwark;

.2 the cupboard is to be made of fire-resisting materials and properly ventilated through the openings in the upper and lower parts.

3.3.3.5 Up to four receptacles may be simultaneously connected to each installation by means of an automatic or non-automatic change-over value. No more than six receptacles including spare ones are to be provided for each installation on board the ship.

On passenger ships having galleys and canteens for passengers up to six receptacles per installation connected by means of an automatic or non-automatic change-over valve may be simultaneously in operation. No more than nine receptacles including spare ones are to be provided for each installation on board such ships.

3.3.4 Storage of spare and empty receptacles.

Spare and empty receptacles which are not stored in the supply unit are to be stored outside the accommodation area in a steel cupboard or closed recesses complying with the requirements of 3.3.3.

3.3.5 Distribution system.

Liquefied gas pipes and their fittings are to comply with the requirements of Part VII "Systems and Piping".

3.3.6 Gas-consuming appliances and their installation.

3.3.6.1 All gas-consuming appliances installed on board the ship are to be approved by a competent body recognized by the Administration.

3.3.6.2 On oil tankers and ships covered by Rules for the Carriage of Dangerous Goods by Inland Waterways, gas-consuming appliances are to be marked as prescribed by the Administration.

3.3.6.3 Gas-consuming appliances are to be fitted with devices to prevent escape of gas in case of extinction of a burner and pilot flame. For water-heating appliances such a device is to have a test flame.

On agreement with the Register, such arrangement may be omitted for gas-consuming appliances installed in the spaces above the upper deck and used only in the presence of the attending personnel.

3.3.6.4 Heating and water-heating appliances are to be connected to a duct for evacuating combustion gases into the open air complying with the requirements of 19.2.4, Part VII "Systems and Piping".

3.3.6.5 Gas-consuming appliances may be installed in the wheelhouse only where are no ducts through which gas is likely to penetrate into the lower parts of the ship.

On oil tankers covered by Rules for the Carriage of Dangerous Goods by Inland Waterways, installation of gas-consuming appliances in the wheelhouse is not allowed.

3.3.6.6 Spaces where gas-consuming appliances are installed are to be equipped in accordance with 3.1 and they are also to meet the following requirements:

.1 they are to be located not lower than the upper deck and be provided with ventilation ensuring efficient removal of combustion products and the necessary air change;

.2 they are to have an access to the open deck and a side scuttle (window) of the opening type. No side scuttle (window) of the opening type may be provided in the galley if there is an exit from the space to a non-living space or corridor with an opening side scuttle or a door leading to the open deck;

.3 where even some part of the space is located below the upper deck, it is to be fitted with mechanical ventilation, and a hood is to be provided above the range;

.4 a ventilation louver with a cross-sectional area of not less than 0,02 m^2 for each water-heating appliance is to be provided in lower part of the water-heating appliance space;

.5 bulkheads and decks are to be tight; door sills are to be at least 150 mm high. No stairways or lifts to the spaces located below are allowed;

.6 the height of the space is to be not less than 2,2 m. Where a hood above the range projects beyond the range the height may be reduced to 1,9 m;

.7 a powder or carbon dioxide extinguisher is to be installed at the entrance to the gas-consuming appliance space;

.8 instructions on use of gas installations and safety rules are to be fixed in conspicuous place on board the ship.

3.3.6.7 The distance from gas-consuming appliances to bulkheads is to be at least 75 mm.

3.4 LIGHTING

3.4.1 Lighting on board ships is to be electrical and is to meet the requirements of Part IX "Electrical Equipment".

3.4.2 The use of other means of lighting on non-self-propelled ships is subject to special consideration by the Register.

4 FIRE-FIGHTING EQUIPMENT AND SYSTEMS

4.1 GENERAL

4.1.1 The requirements of the present Section apply to fire extinguishing systems intended for fire protection of the ship.

Where fire extinguishing systems are used on board the ship, in addition to those required by the present Section (e.g., inert gases extinction systems), they are also to comply with the requirements set forth below in the scope specially agreed upon with the Register in each particular case.

4.1.2 Fire extinguishing systems, fire-fighting equipment and outfit are to be so constructed that they will be efficient and ready for immediate use under all operation conditions.

4.1.3 Construction of all fire extinguishing systems is to be such as to allow their regular testing in operation.

4.1.4 When manufacturing fire extinguishing systems, the requirements of Part VII "Systems and Piping" are to be met.

4.1.5 Materials used for manufacture of fire extinguishing systems equipment are to be non-combustible and resistant to the impact of a fire extinguishing medium and environmental conditions.

4.1.6 Pipes of fire extinguishing systems are not to run through fuel oil and lubricating oil tanks and refrigerated spaces on all ships, and through pump rooms on oil tankers.

4.1.7 Depending on their purpose, the ship's spaces are to be protected by fire extinguishing systems in accordance with Table 4.1.7.

The Register may consider the use of other equivalent systems.

4.1.8 Fire extinguishing media approved by the competent bodies recognized by the Administration are to be used in fire extinguishing systems.

The use of fire extinguishing media, which either by itself or under expected conditions of use give off toxic gas in a quantity that can endanger persons is not allowed.

4.1.9 A fire extinguishing media in fire smothering systems is to be discharged to each protected space through a separate pipe, a shut-off valve of which is to be located within the fire extinction station.

One distribution pipe for a group of small similar spaces may be used.

The requirement is not applicable to foam fire extinguishing systems of oil tankers.

4.1.10 Pipes of gas fire extinguishing systems may run through accommodation and service spaces other than corridors, only if the pipes do not have any detachable joints within the whole length of the spaces and if they have been subjected to tightness tests by a pressure required for hydraulic tests of manifolds in fire extinction stations.

When the pipes are laid through the corridors of accommodation and service spaces the use may be made of detachable joints, their number being kept to a minimum.

4.1.11 The starting system is to ensure the required starting of the fire extinguishing system under all operation conditions of the ship.

Automatic release of a fire extinguishing medium is not allowed, except in case referred to in 4.6.1.2.

4.1.12 Starting valves are to be controlled by flywheels or levers rigidly connected to rods or rollers. Starting handles of foam fire extinguishing or fire smothering systems are to be so constructed that a possibility of their sealing is provided. Irrespective of the fact whether or not a remote control is available, a local manual control is to be provided directly from the fire extinction station, and for the pump — from the place of its installation.

4.1.13 Tugs and pushers intended for operation with the ships carrying combustible materials and flammable liquids are to be fitted with a foam fire extinguishing system capable of extinguishing a fire on the ships served by them. The equipment and parameters of the system (including a quantity and type of a foam concentrate) are to be specified by the designer on agreement with the customer.

4.1.14 On non-self-propelled ships operated without crews no fire-fighting arrangements are required.

Table 4.1.7

Description of spaces	Fire extinguishing systems[1]			
	Water fire main	Foam fire extin-guishing	Sprinkler[5]	Gas fire extinguishing
1 Control stations	0	—	0[6]	—
2 Accommodation spaces	0	—	0	—
3 Domestic service spaces[2]:				
.1 storerooms for compressed and liquefied gases, highly flammable liquids, combustible materials and substances	0	+[3]	+	+
.2 galleys, pantries, water heater rooms, motion picture projector rooms, storerooms for other dangerous goods, ship workshops	0	—	0	—
4 Cargo spaces:				
.1 tanks for flammable liquids, cargo decks of ships for the carriage of packaged flammable liquids or motor vehicles with fuel oil in tanks	0	0	—	—
.2 closed spaces for highly flammable substances and materials, motor vehicles with fuel oil in tanks	0	+	—	+
.3 for the carriage of other dangerous dry cargoes	0	—	—	-
5 Machinery spaces:				
.1 for main, auxiliary and emergency engines and oil-fired boilers, fire pump rooms	0	+[4]	—	+
.2 for generators and emergency sources of electrical power, main and emergency switchboards, electric motors (including propelling motors) and ventilation systems for the above equipment	—	—	—	0
.3 for not oil-fired auxiliary machinery and equipment	0	—	—	—
6 Main supply tanks, daily, slop, settling tanks for fuel oil and lubricating oil, bilge water, etc., cofferdams	0	+[3]	—	+
7 Cargo pump rooms of oil tankers	0	+	—	+

[1] For the purpose of the table the following symbols have been adopted:"0" means that the spaces are to be protected by the above systems; "+" means that the spaces are to be protected by one of the above systems;"—" means that no protection by the above systems is required;
[2] The spaces are to be fitted with fixed fire extinguishing systems where the volume of the space exceeds 3 m^3.
[3] For protection of the spaces portable foam nozzles or foam generators may be used in lieu of the fixed foam fire extinguishing system.
[4] A foam fire extinguishing system with a foam expansion ratio 1000:1 is to be used.
[5] A need in installation of a fire extinguishing system is to be specified by the Customer.
[6] The wheelhouse is to be fitted with automatic sprinkler system.

4.2 FIRE EXTINCTION STATIONS

4.2.1 The equipment of all fire extinguishing systems other than the water fire main system is to be arranged in fire extinction stations outside the protected spaces.

4.2.2 All fire extinction stations other than those for machinery spaces are to be arranged on the open decks or directly below them and to be directly accessible from the open deck. Fire extinction stations for machinery spaces may not have a direct exit to the open deck only in case where provision is made for remote release of a fire extinguishing medium from the wheelhouse or other spaces having a direct exit to the open deck.

4.2.3 Fire extinction stations are to be arranged aft of the collision bulkhead, and outside the cargo area on oil tankers.

4.2.4 Fire extinction stations are to be arranged in gastight enclosures and be separated from the protected spaces by fire-resisting divisions.

4.2.5 Fire extinction stations spaces are to be provided with heat insulation and heating ensuring serviceability of the equipment installed therein; an air temperature in the space is not to exceed 40 °C.

4.2.6 The air temperature in the fire extinction station is to be controlled with a thermometer so fitted as to make its indications visible both from inside the station and, through a scuttle, from outside of the space.

4.2.7 The station is to have natural and electric lighting supplied from the ship's mains and from an emergency source.

4.2.8 Entrance doors to the station are to open outside and to be permanently locked. A lock is to have two keys, one of which is to be kept in a closed case with a glazed wall in the vicinity to the lock and the other in the wheelhouse.

4.2.9 A diagram of the system showing triggering devices and the protected spaces, as well as instructions on putting the system into operation and maintenance in languages adopted by the Administration are to be exhibited in a conspicuous position in the fire extinction station.

If triggering devices are installed outside the fire extinction station they are to be identified by the plate with a symbol and the text in red letters on a white background: "Fire-fighting installation". The plate is to be posted up visibly and have a side length of at least 10 cm. Next to each triggering device operating instructions are to be posted up as indicated above.

4.2.10 Valves and arrangements at the station are to be provided with plates indicating their purpose and "open — closed" position indicators.

4.3 WATER FIRE MAIN SYSTEM

4.3.1 Number and capacity of fire pumps.

4.3.1.1 On self-propelled and non-self-propelled ships provided with their own fixed sources of power having power output 110 kW and over a water fire main system is to be installed with power-driven pumps, the number of which is to meet the requirements given in the table of Appendix.

On agreement with the Register the fixed water fire main system may not be installed on ships with a crew less than 3 persons.

4.3.1.2 For fire-fighting purposes, along with special fire pumps, sanitary, ballast, bilge and other pumps may be used, the capacity and pressure head of which are not less than the design values for fire pumps.

4.3.1.3 Fire pumps are to be capable of delivering an efficient jet of water to each part of the ship.

Capacity calculation is to be based on the condition of simultaneous delivery of water to 15 per cent of the total number of all hydrants installed on board the ship, but not less than to three hydrants, and for ships with main engines having power output up to 220 kW inclusive, to at least two hydrants, the jets being delivered through the largest nozzles used in the ship.

The minimum capacity of a fire pump is to be 20 m^3/h.

4.3.1.4 If other fire extinguishing systems using water supplied by fire pumps are installed on board the ship (foam fire extinguishing system, pressure water-spraying system, drenching system, etc.), the capacity of the pump is to be sufficient for delivery of water by the water fire main system to any part of the ship and for parallel operation of one of the above systems that require the largest quantity of water.

4.3.1.5 A pressure head in the system is to be sufficient to ensure parallel operation of systems referred to in 4.3.1.4, a pressure at hydrants being not less than 0,3 MPa.

4.3.2 Requirements for fire pumps.

4.3.2.1 On all self-propelled ships fire pumps are to have an independent mechanical drive. Use of a V-belt drive is not allowed.

In separate cases, the Register may allow use of main engine-driven fire pumps, provided the propulsion unit is so designed as to provide fire pump operation when the ship is at mooring and disconnection of the pump when the ship is under way.

On agreement with the Register a V-belt drive from the main engine to the pump may be used, provided transmission of a torque is ensured even when one of the belts is broken.

4.3.2.2 Fire pumps are to be driven from the sufficient sources of power capable to ensure operation of pumps under any operation conditions of the ship, including the condition when the ship is at mooring.

4.3.2.3 Fixed fire pumps may be used for other shipboard services provided at least two independently driven pumps are installed on board the ship, of which one is at all times kept readily available for its intended purpose. Where only one fire pump is installed on board the ship, it may be used for other purposes requiring only short-time consumption of water (e.g. flushing out of decks, hawse pipes, etc.).

4.3.2.4 Pumps and pipes intended for fire-fighting purposes may neither be used for pumping of petroleum products or other flammable liquids nor as ballast pumps for tanks used for alternate carriage of fuel oil and water ballast.

4.3.2.5 Pumps that are likely to develop in the fire main a pressure exceeding the permissible value are to be provided with bypass valves to discharge water from the delivery to the suction pipe as well as with a pressure gauge to be installed on the delivery pipe before shut-off valves.

Bypass valves are to be set to operate at a pressure exceeding the working pressure in the fire main by no more than 10 per cent.

4.3.2.6 Fixed fire pumps and their sea valves are to be located below the light-draught waterline of the ship.

On agreement with the Register, the fire pump may be installed above the waterline, provided efficient self-priming means are available.

Provision is to be made for water suction by fire pumps from two sea valves located on the opposite sides of the ship.

4.3.2.7 On passenger ships an emergency fire pump is to be installed outside the machinery space. The following requirements are to be met:

.1 the emergency fire pump is to be driven from a compression ignition engine or from an electric motor powered from an emergency diesel-generator. Where the pump is driven from an internal combustion engine, a service oil fuel tank of sufficient capacity to ensure at least three hour operation of the pump is to be provided in the emergency fire pump room;

.2 the capacity of the emergency fire pump is to comply with the requirements of 4.3.1.3 and 4.3.1.4 and to be sufficient for simultaneous delivery of at least two water jets to any part of the ship from two different fire hoses. The effective range of throw of a jet from each hose nozzle is to be at least 12 m with pressure at the hydrants of at least 0,3 MPa. The minimum capacity of the emergency fire pump is to be 20 m^3/h;

.3 the pump is to be connected to the ship's fire main;

.4 the pump, water fire main that runs from the pump, its sources of power, sea valves are to be so arranged as not to be rendered inoperative by a fire in the main fire pump space;

.5 the pump is to be located aft of the collision bulkhead and to be placed in a room having a separate entrance independent of the main fire pump space.

4.3.3 Pipes.

4.3.3.1 Diameters of the water fire main and service pipes are to be such that a water velocity in pipes at any pipe section is not more than 4 m/s.

4.3.3.2 Water fire main sections passing through non-heated spaces and located on open decks are to be provided with shut-off fittings for their isolation from the pipes running through heated spaces as well as with water drainage arrangements.

4.3.3.3 Each fire pump is to be fitted with shut-off valves on suction and discharge pipes. The use of slide valves on suction pipes is allowed.

Non-return shut-off valves are to be provided on discharge pipes of centrifugal pumps. Where two or more centrifugal pumps are used, non-return shut-off valves are to be fitted on discharge pipes of each pump.

4.3.3.4 Pipelines of the water fire main system are to be of steel seamless pipes with a corrosion-resistant coating applied on the inner and outer sides.

4.3.3.5 Valves and fittings are to be of steel, bronze, copper or, on agreement with the Register, of other materials.

4.3.3.6 On passenger ships of 50 m in length and over, the water fire main is to comply with the following requirements:

.1 be designed as a loop system;

.2 have at least two cross pipes with isolating valves fitted on each of them and on the side pipes of the main;

.3 a jet with a range of throw not less than 6 m is to be provided on the uppermost deck.

4.3.4 Fire hydrants.

4.3.4.1 Each fire hydrant is to have a shut-off valve and a standard quick-coupling connection. Hydrants fitted on open decks are to have also quick-acting plugs.

4.3.4.2 Fire hydrants are to be so arranged on board the ship as to ensure simultaneous delivery of two water jets to any part of the ship by standard fire hoses not more than 20 m long.

4.3.4.3 Fire hydrants are to be placed:

on open decks — in way of exits from superstructures and trunks as well as next to cargo hatches;

inside the spaces — in corridors and lobbies, engine and boiler rooms;

after the fire pump — on the delivery pipe directly between the screw-down (non-return shut-off) valve and the pump.

Fire hydrants are to be placed at a distance of not more than 1,35 m from decks or flooring.

On each deck and in long interior spaces and corridors fire hydrants are to be spaced not more than 20 m apart.

4.3.4.4 On ships of 50 m in length and over isolating valves spaced not more than 30 m are to be fitted in readily accessible places on the linear water fire main.

On oil tankers of more than 50 m in length, shut-off valves in every 20 m are to be provided on the water fire main in the open deck. Twin hydrants are to be placed between two neighboring shut-off valves.

4.3.4.5 On ships carrying deck cargoes fire hydrants are to be located in readily accessible places; they are to be protected against physical damage by such cargo.

4.3.4.6 In engine and boiler rooms at least two fire hydrants placed on the opposite sides of the ship are to be provided. On ships with propulsion power less than 736 kW a hydrant located directly at the fire pump (between the pump and the shut-off valve) may be used as one of them.

In engine rooms of ships with propulsion power less than 220 kW, if there is a fire hydrant next to the fire pump, no more hydrants are needed.

4.3.4.7 Tugs, icebreakers and floating docks are to have manifolds fitted with quick-coupling connections to be arranged on open decks and intended for water supply to other ships.

4.3.4.8 All fire hydrants are to be painted red and numbered.

4.3.5 Fire hoses and nozzles.

4.3.5.1 Fire hoses approved by the competent bodies recognized by the Administration are to be used on board ships.

4.3.5.2 Fire hoses are to meet the following requirements:

.1 they are to be 10 to 20 m long if used with fire hydrants placed on open decks and not less than 10 m long if used with fire hydrants in the ship's spaces;

.2 they are to be made of the approved wear-resistant materials not liable to destruction by microorganisms (decay);

.3 the diameters of the hoses and couplings are to be compatible with the diameters of standard fire nozzles coupled thereto.

4.3.5.3 The number of the fire hoses is to be equal to that of fire hydrants installed on the ship.

4.3.5.4 Each fire hose in assembly with a fire nozzle is to be located in the vicinity of the fire hydrant for which it is intended on hose reels or in baskets. On open decks fire hoses are to be stowed in special properly marked lockers.

4.3.5.5 Nozzles are to be of dual purpose capable of producing both a jet and a spray.

4.3.5.6 Standard nozzle sizes are to be 12, 14, 16, 19 mm or as near thereto as possible as to obtain the maximum discharge from two jets from the smallest capacity pump.

On open decks of cargo ships of 1000 gross tonnage and more, on passenger ships of 50 m in length and over, dredgers and floating docks, the nozzle size is to be at least 16 mm. On tugs and pushers, having total capacity of their main engines less than 900 kW, 12 mm hand fire nozzles may be used on open decks, provided operation of the foam fire extinguishing system on these ships is ensured by a fire pump.

On small ships the use of nozzles less than 12 mm in diameter is allowed.

4.3.6 Tests of water fire main systems for strength and tightness.

Water fire main systems are to be tested for strength in a workshop and for tightness after installation on board the ship in compliance with the requirements of Table 4.3.6.

Table 4.3.6

Items to be tested	Test hydraulic pressure, in MPa	
	in a workshop	on board the ship
Pipelines from sea valves to pumps	—	2
Pipelines from pumps to fire hydrants	$1,5p$[1]	in action
Fittings	$1,5p$ but not less than 0,2 MPa	in assembly with the system

Note. p = working pressure in the system.

[1] In case the test is conducted with that pressure after installation on board the ship, the test may be omitted.

4.3.7 Additional requirements for water fire main system on ships carrying dangerous goods.

4.3.7.1 The system is to be supplied by two independent fire or ballast pumps, one of which is to be ready for use at any time. These pumps, as well as their drives and electrical equipment are not to be installed in the same space.

4.3.7.2 The system is to be provided with a water main with at least three hydrants, located in the protected area above deck, for which suitable and sufficiently long hoses with nozzles are to be provided. It is to be possible to reach any point of the deck in the protected area simultaneously with at least two jets of water which do not emanate from the same hydrant. A spring-loaded non-return valve is to be fitted to ensure that no gases can escape through the water fire main system into accommodation and service spaces outside the protected area.

4.3.7.3 The capacity of pumps supplying the system is to be sufficient for a jet of water to reach a distance of not less than the ship's breadth from any location on board with two spray nozzles being used at the same time.

4.4 FOAM FIRE EXTINGUISHING SYSTEM

4.4.1 The foam fire extinguishing systems are to be capable to produce air mechanical foam for the use as an extinguishing medium depending on the foam expansion ratio:

of low expansion ratio (about 10:1);

of medium expansion ration (between 50:1 and 150:1);

of high expansion ration (about 1000:1).

Foam fire extinguishing systems may include units separately producing, but simultaneously supplying low expansion ration foam and medium expansion ratio foam (combination foam).

4.4.2 Foam concentrate types approved by the Register are to be used.

4.4.3 The capacity of a foam fire extinguishing system and quantity of a foam concentrate are to be calculated depending on the foam expansion ratio, the rate of solution supply and operation time of the system as indicated in Table 4.4.3.

Table 4.4.3

Spaces	Rate of solution supply, in l/min·m^2, with foam expansion ratio			Design time of continuous operation, in min
	10 : 1	100 : 1	1000 : 1	
Cargo tanks for flammable liquids with flash point 60 °C and below and decks where the tanks are located	(6, 0,6, 3)[1]	6[3]	—	30[2]
Cargo tanks for flammable liquids with flash point above 60 °C and fuel oil tanks	6[3]	4,5[3]	—	20
Dry cargo holds	—	4,0[3]	—	45
Machinery and other spaces with oil-fired equipment	—	4,5[3]	—	20
	—	—	1,0[3]	The time of operation is to be suffi-cient to produce a volume of foam equal to five times the volume of the protected space
Storerooms for flammable liquids, materials and substances, liquefied and compressed gases	—	4,5[3]	—	

[1] The rate of solution supply is to be such as to provide the largest throughput of the system and is to be not less than the following;

6 1/min per 1 m^2 of the horizontal sectional area of the single tank having the largest area;

0,6 1/min per 1 m^2 of the cargo tank area determined as a product of the moulded breadth of the ship by the length of the cargo tank deck;

3,0 1/min per 1 m^2 of the area protected by a monitor with the largest capacity, such area being located entirely forward of the monitor, but not less than 12501 l/min.

[2] On oil tankers equipped with an inert gas system, the design time of system operation is to be not less than 20 min.

[3] The horizontal sectional area of the largest protected space is to be taken as the design area.

4.4.4 The expansion ratio of the foam normally used in the low-expansion foam fire extinguishing systems is normally not greater than 1:12. Where the actual expansion ratio is more than 12:1, the expansion ratio 12:1 is to be assumed as the design value. In case the actual expansion ratio is below 12:1, the quantity of the foam concentrate is to be proportionally increased.

4.4.5 Tanks for storage of a foam concentrate are to be fitted with filling and drainage arrangements, a level indicator and a manhole for cleaning and inspection. The tanks are to be of sufficient capacity to contain the full amount of the foam concentrate required.

Where no excessive pressure is to be created in tanks during system operation non-return valves are to be fitted between such tanks and the fire main.

4.4.6 Where a foam concentrate using fresh water is utilized in high-expansion ratio foam fire fighting systems of ships intended to navigate also in salt water basins, water supply not less than for single flooding of the protected space with foam is to be stored in a tank at the foam fire extinction station. The remaining water may be supplied from the ship's water storage tanks.

4.4.7 Mixers for making an aqueous solution of a foam concentrate of the required concentration, foam generators and air-foam nozzles are to be of a type approved by the Register. The design consumption of the foam concentrate through a mixer is to be sufficient to ensure operation of simultaneously used foam nozzles and/or foam generators.

4.4.8 The foam fire extinction station is to be located outside the cargo area, in the vicinity of accommodation spaces and to be readily accessible.

4.4.9 A pressure gauge is to be fitted on water supply pipe inside the station.

4.4.10 Foam is to be supplied through manual air-foam nozzles, portable foam generators and monitors.

4.4.11 An air-foam nozzle used in the ship's spaces is to be capable of delivering not less than 2 m^3 of foam per minute.

4.4.12 A portable medium-expansion foam generator is to comply with the following requirements:

.1 a design solution discharge rate is to be at least 360 l/min at a pressure before a foam generator of about 0,6 MPa;

.2 a range of a foam jet throw is to be not less than 8 m.

4.4.13 On a special agreement with the Register, the use of the deck main for both foam fire extinguishing system and water fire main system is allowed.

4.4.14 The fixed foam fire extinguishing system for dry cargo ships is to meet the following requirements:

.1 a shut-off valve is to be fitted where the foam fire main is led out to the open deck;

.2 valve chests with fire hydrants are to be provided on the foam fire main on both sides of the ship. The distance between the valve chests on either side of the ship is not to exceed 40 m. The number of fire hydrants in each valve chest is to be equal to 50 per cent of the required number of foam generators.

4.4.15 Where a ship is equipped with a fixed low- and/or medium-expansion foam system, there must be provided branch pipes from the solution supply pipeline to entrances to machinery spaces from the upper deck, as also to the fuel oil filling positions. Each branch pipe is to be fitted with two hydrants for coupling fire hoses with air-foam nozzles or foam generators thereto.

4.4.16 The high-expansion foam system is to meet the following requirements:

.1 a foam generator is to be of a design approved by the Register, capable of producing high-expansion mechanical foam from the aqueous solution of a foam concentrate;

.2 the cross-sectional area of the foam pipes is to be not less than that of foam generator orifice. Foam pipes are to be so laid that pressure head losses are minimized, and discharge orifices are to be so located that there are no obstructions for free foam discharge into the protected space;

.3 a generator discharge orifice or a foam pipe at the place where it comes outside the station is to be provided with a closing device. The device is to open automatically concurrent with putting the system into operation. A manual control and position indicators "open — closed" are to be provided for the device;

.4 for the purpose of testing the system, a change-over device is to be provided to discharge the foam to the open deck. The device is to be permanently sealed in a position to discharge the foam to the protected space;

.5 equipment essential for operation of foam generators is to be fed from the main and emergency sources of power;

.6 spaces protected by a high-expansion foam system are to have openings for air discharge meeting the requirements of Part III "Arrangements, Equipment and Outfit" and Part VII "Systems and Piping".

4.4.17 On oil tankers a deck foam system is to be provided meeting the following requirements:

.1 the system is to deliver foam to the entire cargo tank area and to any cargo tank which deck was ruptured;

.2 foam is to be supplied by means of monitors and portable foam appliances (air-foam nozzles or foam generators).

Monitors are to be installed on ships of more than 2000 gross tonnage. Other ships may be provided only with portable foam generators or air-foam nozzles capable of supplying a foam concentrate solution with a supply rate not less than 25 per cent of that indicated in footnote 1 of Table 4.4.3;

.3 a monitor is to comply with the following requirements:

to supply a foam solution with a discharge rate not less than 3 l/min per 1 m^2 of deck area protected by that monitor entirely located forward of the monitor, but not less 1250 l/min;

to provide alternate supply of water and foam by means of a changing-over device or shut-off valves that are to be interlocked, for which purpose branch pipes are to run from water and foam pipelines;

the distance from a monitor to the farthest extremity of the protected area forward of that monitor is to be not more than 75 per cent monitor range of throw in still air conditions;

.4 isolating or slide valves spaced 30 m apart are to be fitted on the foam main in readily accessible places on the cargo tank deck. Each valve is to be provided with an information plate to indicate that the valve is to be kept permanently open under normal operation conditions;

.5 before each isolating valve on the foam main at such a distance that the requirements of 4.3.4.2 are met a twin fire hydrant is to be fitted for coupling fire hoses with air-foam nozzles thereto. Branch pipes from the water and foam main pipelines to monitors are to be also located before the isolating valves;

.6 a shut-off valve is to be placed at the fire extinction station where the main extends beyond the boundaries of the station. Before the shut-off valve there must be provided branch pipes to monitors, which are to be installed both port and starboard at the front of the poop or accommodation spaces facing the cargo tank area and a twin fire hydrant for connection of fire hoses with air-foam nozzles.

Where medium-expansion foam is used, valve chests with a number of fire hydrants equal to 50 per cent of the required number of foam generators are to be provided in lieu of twin fire hydrants referred to in 4.4.17.5 and 4.4.17.6.

4.5 GAS FIRE EXTINGUISHING SYSTEMS

4.5.1 For protecting engine rooms, boiler rooms and pump rooms with pumps for transfer of oil products and other flammable liquids, fire smothering systems using CO_2, HFC 227ea and IG-541 (52 per cent nitrogen; 40 per cent argon, 8 per cent carbon dioxide) as the extinguishing agent are applied.

The application of such systems in other rooms as well as the use of other extinguishing agents is subject to agreement with the Register.

4.5.2 The amount of carbon dioxide, in kg, is to be determined by the following formula:

$$G = 1{,}79\ V\varphi \qquad (4.5.2)$$

where V = design volume of the protected space, in m^3;
φ = factor equal to:
0,3 — for dry cargo holds and other spaces other than those indicated below;
0,35 — for machinery spaces, the design volume of which is determined with regard to the full volume of casings;
0,4 — for machinery spaces, the design volume of which is determined without any regard to the volume of casings from the level where the horizontal area of the casings is equal to, or less than, 40 per cent of the machinery space area;
0,45 — for spaces in which vehicles with fuel oil in tanks are carried.

For machinery spaces such value of the factor φ is to be taken which results in a greater value G.

On ships of less than 2000 gross tonnage other than passenger ships, factors 0,35 and 0,4 may be reduced to 0,3 and 0,35, respectively.

4.5.3 The supply of 85 per cent of the design amount of carbon dioxide is to be ensured as follows:

.1 within 2 min for machinery spaces, emergence diesel-generator and fire pump rooms and other spaces where fuel oil or other flammable liquids are used;

.2 within 10 min for spaces where no fuel oil or other flammable liquids are carried or used.

4.5.4 Extinguishing medium is to be stored in cylinders and tanks of an approved type.

4.5.5 If there are several rooms to be protected, the minimum volume of the extinguishing agent is to be equal to the volume necessary for the largest room to be protected. The volume of CO_2 for the room to be protected is to be at least 40 per cent of its gross volume. The number of cylinders for storing liquid carbon dioxide is to be determined depending on the filling ratio (amount of carbon dioxide per 1 litre of cylinder capacity), that is to be:

not more than 0,675 kg/l at the design pressure of carbon dioxide in a cylinder 12,5 MPa and over;

not more than 0,75 kg/l at the design pressure of carbon dioxide in a cylinder 15 MPa and over. When filling a cylinder, a deviation of not more than ±0,5 kg against the design quantity of the carbon dioxide for each cylinder is allowed.

In the case referred to in 4.5.26, the filling ratio is to be reduced by 0,075 kg/l as against the limit values indicated above.

4.5.6 CO_2 containers are to be housed outside the rooms to be protected in fire extinction stations, gastight partitions or cabinets with their doors adequately marked. The equipment of carbon dioxide smothering stations is to meet the requirements of 4.2 and the following additional requirements:

.1 cylinders are to be placed vertically in rows on the pads, which may be made of wood;

.2 cylinders are to be efficiently secured, accessible for inspection and checking of the amount of the carbon dioxide contained therein;

.3 a carbon dioxide smothering station is to have arrangements for weighing the cylinders or measuring the level of the liquid therein;

.4 each cylinder is to be marked with an ordinal number;

.5 pilot cylinders are to be fitted within the fire extinction station and to be painted with a special paint;

.6 doors of the stations are to be properly marked.

4.5.7 Valves of cylinders of carbon dioxide smothering system are to meet the following requirements:

.1 they are to have protective devices. Protective diaphragms are to break at a pressure rise in the cylinder up to $(1,3 \pm 0,1)P$ where $P =$ design pressure in the cylinder. For valves with slotted diaphragms, which are additionally fitted with protective diaphragms, the breaking pressure of the slotted diaphragms is to be at least 1 MPa more than the highest value of the protective diaphragm breaking pressure. There must be provided a checking device to indicate that the protective device has actuated;

.2 the valve-opening device is to be of a lever type and to ensure full opening of the valve by turning the lever to an angle not more than 90°. The device is to permit the valves to be opened individually or by groups;

.3 the cylinder valves are to be fitted with scarfed pipes cut short at 5 to 15 mm from the cylinder bottom. The inside diameter of the pipes and the pipes connecting cylinder valves with the manifold is to be not less than 10 mm;

.4 where the design of valves of the pilot cylinders differs from that of the valves of all other cylinders, they are to be painted with a paint of another colour and have the inscription "pilot".

4.5.8 Gas from the protective valves is to be discharged outside the station to the atmosphere through a separate pipe provided with an audible alarm at the outlet or to the distribution manifold where provision is to be made for:

two pipes, one of which is open-ended and fitted with a shut-off valve, and the other is provided with a protective diaphragm;

a signaling device to indicate the presence of pressure in the manifold, led to a permanently attended space. In such case, a device to indicate that the protective device has actuated is not required for the valves.

4.5.9 The pipe connecting a cylinder with the manifold is to be seamless and to be made of red copper. The use of special flexible hoses made of the approved materials is allowed.

A non-return valve is to be fitted on the pipe. A drainage arrangement of manifolds is to provide their complete drainage.

4.5.10 A manifold of the carbon dioxide fire smothering station is to be fitted with a pressure gauge graduated to a value of at least 1 MPa in excess of the a hydraulic test pressure of carbon dioxide cylinders. The value of the pressure gauge scale division is not to exceed 0,5 MPa.

4.5.11 Sealing materials for valves and flexible hoses are remain operative at low temperatures down to -60 °C.

4.5.12 The total cross-sectional area of manifolds and cross-sectional area of the distributing manifold are to be not more than the sum of cross-sections of the valves simultaneously opening for the largest (by volume) protected space (for high-pressure systems) and not more than the cross-section of the discharge valve of the tank (for low-pressure systems).

4.5.13 The cross-sectional areas of distributing pipes for individual protected spaces are to be not more than the total cross-sectional area of the discharge valves of the cylinders simultaneously opening for the space concerned. The total cross-sectional area of discharge pipes is not to exceed the cross-sectional area of the supply pipe.

4.5.14 Each pipe to individual spaces is to be fitted with a shut-off valve.

4.5.15 Carbon dioxide is to be supplied to the protected spaces through nozzles arranged in the upper part of the spaces. The uniform distribution of the medium throughout the volume of the spaces is to be provided.

Where the floor plates in the machinery spaces are placed higher than one meter above the bottom (double bottom), a number of nozzles (about 15 per cent) are to be positioned in the upper part of the space below the plates.

4.5.16 The total sectional area of nozzle outlets in the space concerned is not to exceed 85 per cent of the total cross-sectional area of the distribution pipline.

4.5.17 Perforated pipes may be used instead of nozzles in silencers, exhaust-gas boilers and smoke stacks. The total are of pipe perforations is to be by 10 per cent less than the pipe cross-section.

4.5.18 It is recommended to provide remote discharge of carbon dioxide into the spaces referred to in 4.5.3.1 from the main fire control station or from a position in the vicinity of the entrances to the spaces. The release controls are to be positioned so that they can be operated in case of fire in the protected space.

4.5.19 Automatic release of extinguishing medium is not allowed.

4.5.20 Release controls at the fire extinction station are to ensure simultaneous opening of cylinder valves intended for the above spaces.

4.5.21 An alarm on extinguishing medium discharge into the protected space is to operate at the station from which the system is remotely started. Depending on the location of the station it may be done with a special signaling device, a need in which is subject to special consideration by the Register in each particular case.

4.5.22 Pipelines conveying carbon dioxide from pilot cylinders to servomotors are to be fitted with shut-off valves interlocked with an opening device of pilot cylinders.

4.5.23 Fixed gas fire extinguishing systems are to be provided with means for giving a warning alarm on gas release. The alarms are to be clearly heard in the spaces where personnel normally work or to which they have access under normal operating conditions as well in the spaces from where people can be evacuated only through the flooded spaces.

The alarm is to operate for not less than 20 s before the gas is released, it is to be clearly heard under operating conditions with the highest level of noise and with the doors to the spaces to be evacuated when the system is brought into operation closed.

4.5.24 Closing of all openings through which the air can enter or the extinguishing medium can escape is to be provided in the spaces protected by the carbon dioxide fire smothering system. Controls for closing of openings are to be arranged outside the protected spaces or at places not likely to be cut off by a fire in the protected space.

4.5.25 A plate of an established standard with a description of the alarm signal and actions to be taken when the alarm sounds in the languages required by the Administration is to be placed at each entrance to and exit from a space to which extinguishing medium may be released.

4.5.26 In sound cases, local stations with not more than five cylinders (containing no more than 125 kg of carbon dioxide) may be allowed for certain protected spaces.

Carbon dioxide cylinders for protection of crankcases and silencers of internal combustion engines, of smoke stacks and other enclosed spaces may be installed inside machinery spaces.

4.5.27 Fire extinguishing systems using HFC-227ea as the extinguishing agent are to comply with the applicable requirements of the present Chapter as well as the following additional requirements:

.1 if there are several rooms to be protected, each with a different gross volume, each room is to be equipped with its own fire extinguishing system;

.2 the volume of HFC-227ea for the room to be protected is to be at least 8 per cent of the room's gross volume. This volume is to be supplied within at least 10 s;

.3 the containers are not to be filled to more than 1,15 kg/l. The specific volume of the unpressurized HFC 227ea is to be taken as 0,1374 m^3/kg;

.4 each container is to be fitted with a manometer and a pressure sensor which triggers an acoustic and optical alarm signal in the wheelhouse or other room in the event of an unauthorized loss of propellant;

.5 each container that is installed in the room to be protected is to be equipped with an overpressure relief valve releasing the contents of the container into the room to be protected;

.6 the fire extinguishing system is not to contain any parts made of aluminium.

4.5.28 Fire extinguishing systems using IG-541 as the extinguishing agent are to comply with the applicable requirements of the present Chapter including 4.5.27.1 and 4.5.27.5.

The volume of IG-541 for the room to be protected shall be at least 44 per cent and no more than 50 per cent of the room's gross volume. This volume shall be supplied within 120 s.

4.6 SPRINKLER SYSTEM

4.6.1 General.

4.6.1.1 Pipes of the sprinkler system are to be permanently filled with water except for short sections on open parts of decks or in non-heated spaces which can be kept dry, on special agreement with the Register. Any parts of the system that can be exposed to low temperatures are to be properly protected against freezing.

4.6.1.2 The sprinkler system is to be automatically set in operation at a temperature in the protected space rising to the values indicated in 4.6.4.2.

4.6.1.3 Water supply arrangements of the sprinkler system are to be fitted with a pressure tank, control valves, both automatically starting pump and air compressor with an air cylinder to maintain the working pressure in the system and to ensure immediate delivery of water to the opened sprinklers.

4.6.1.4 The air cylinder, compressor, pump and pipes of the sprinkler system, except for the pipeline connecting the sprinkler system to the water fire main system, are to be independent of other systems.

4.6.1.5 A sprinkler pump and a pressure tank are to be arranged outside the protected spaces.

Fire extinction stations or permanently manned positions are to be fitted with a pressure gauge to indicate the pressure in the system.

4.6.1.6 Sprinkler systems which rated parameters differ from those given in the present Chapter are subject to special consideration by the Register in each particular case, basing on the "Revised Guidelines for Approval of Sprinkler Systems Equivalent to that Referred to in SOLAS Regulation II-2/12" adopted by IMO Resolution A.800(19).

4.6.2 Sprinkler pumps.

4.6.2.1 The pump is to start up automatically by a pressure drop in the system and be capable of supplying water to the system before the standing fresh water charge in the pressure tank is completely exhausted. Means are to be provided for testing automatic operation of the pump.

4.6.2.2 The pump and piping system are to be capable of maintaining the necessary pressure at the level of the highest sprinkler to ensure continuous output of water sufficient for simultaneous coverage of a minimum floor area of 75 m^2 at a supply rate referred to in 4.6.4.1.

4.6.2.3 The pump is to be fitted on the delivery side with a test valve with an open-ended discharge pipe, the cross-sectional area of which is to be compatible with the capacity of the pump while maintaining the pressure in the system according to 4.6.2.2.

4.6.2.4 The sea inlet to the pump is normally to be in the space containing the pump, the shut-off valve of which is to be fixed in the opened position. A strainer with a mesh size sufficient for operation of the sprinklers is to be fitted on the seawater suction pipe.

4.6.2.5 The sprinkler system is to have a connection with the ship's fire main. A lockable screw-down shut-off valve is to be fitted at the connection.

4.6.2.6 The pump and control valves are to be driven from at least two independent sources of power, each being capable of ensuring their operation.

One of the power sources may be an internal combustion engine so placed that a fire in the protected space will not interrupt air supply to the engine.

Where the pump is electrically driven, its drive is to meet the requirements of Part IX "Electrical Equipment".

4.6.3 Pressure tank.

4.6.3.1 The pressure tank is to be fitted with the following instruments and devices:

.1 an automatic pressure maintaining device;

.2 a water level control device and alarms warning of a water level and pressure drop in the tank below the normal values;

.3 a relief valve that is connected to the water space of the tank and that cannot be disconnected;

.4 a pressure gauge.

4.6.3.2 The pressure tank is to contain a standing charge of fresh water equivalent to the amount of water that is discharged in one minute by the sprinkler pump.

The volume of the pressure tank is to be equal to at least twice that of the charge of water specified above.

A connection is to be provided for replenishing the fresh water charge in the tank.

4.6.3.3 Arrangements are to be provided for maintaining an air pressure in the tank such as to ensure that where the standing charge of the fresh water in the tank has been used the pressure in the tank will not be less than the working pressure of the sprinkler plus the pressure exerted by a head of water measured from the bottom of the tank to the highest sprinkler in the system.

Arrangements for replenishing the air under pressure are to be provided.

4.6.3.4 The pressure tank is to be installed in a heated space.

4.6.3.5 The pressure tank construction is to meet the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

4.6.4 Sprinklers.

4.6.4.1 Sprinklers are to be installed in the protected space in an overhead position and spaced in a suitable pattern to maintain an average application rate of not less than 5 l/min per 1 m^2 of the area of the protected space.

The Register may allow the use of other application rates depending on structural features of the protected space.

4.6.4.2 In accommodation and service spaces sprinklers are to come into operation within a temperature range between 68 and 79 °C.

On passengers ships sprinkler heads are to operate at a temperature not exceeding 70 °C.

In drying rooms and galleys an operation temperature may be increased to a value not more than 30 °C above the maximum deckhead temperature.

4.6.4.3 Sprinklers are to be made of a corrosion-resistant material. Sprinklers of galvanized steel are not allowed.

4.6.5 Control valves.

4.6.5.1 Control valves are to be fitted on the supply pipe of each section of the sprinkler system and are to ensure:

.1 delivery of water from water supply sources when any of the sprinklers fitted in the section comes into operation;

.2 giving of visual and audible alarm whenever any sprinkler in the section comes into operation. The signal is to simultaneously operate directly at the position where the control valve is fitted, at the main fire control station and in the machinery space where a watchkeeper is permanently present. It is to indicate the section containing the sprinkler that has opened. The alarm system is to indicate also occurrence of any fault in the system;

.3 a possibility of checking the operation of the system through a special test valve with the cross-sectional area equal to that of the sprinkler. The test valve for each section is to be positioned near the stop valve of each section.

4.6.5.2 A control valve is to be fitted with a pressure gauge.

4.6.5.3 Control valves are to be placed in special metal enclosures or lockers outside the protected space.

Places where control valves are fitted are to be readily accessible, illuminated and closed by a glazed door permitting to watch the condition of all parts of control valves and especially pressure gauges readings.

4.6.5.4 A list or plan is to be displayed at each control valve showing the spaces covered and the location of the particular section in relation to other sections. Suitable instructions on testing and maintenance of the system are also to be exhibited.

4.6.5.5 One of the control valves is to have a switch to enable the alarms and indicators for each section of sprinklers to be tested.

4.6.6 Pipes.

4.6.6.1 Sprinkler systems are to be subdivided into separate sections. Each section is to serve only one main fire zone or a watertight compartment and not more than two decks. Each section is to contain not more than 200 sprinklers.

4.6.6.2 Diameters of pipes of the sprinkler system are to be such as to ensure operation of sprinklers at a water pressure and discharge rate specified in 4.6.4.1 and 4.6.2.2. The pipelines are to meet the requirements of Part VII "Systems and Piping".

4.6.6.3 Pipelines are to be made of corrosion-resistant materials.

4.6.6.4 Means are to be provided in each section for purging the pipes with compressed air and flushing them with fresh water.

4.6.6.5 Each section of sprinklers is to be capable of being isolated with one stop valve only, after which a pressure gauge is to be fitted.

4.6.6.6 The stop valve is to be fitted before the control valve and placed together with it in a metal enclosure referred to in 4.6.5.3.

The stop valve of each section is to be readily accessible, and its location is to be clearly and permanently marked.

Measures are to be taken to prevent the operation of stop valves by any unauthorized person.

4.6.6.7 Suction pipes of the pumps supplying water to the sprinkler system are to be fitted with filters preventing clogging of the system and sprinklers.

4.6.6.8 For navigation in sea areas pipes of the sprinkler system are to be provided with non-return stop valves to prevent sea water from penetration into the pressure tank and leakage of water from the tanks and the system.

4.6.6.9 Stop valves between the discharge pipe of the pump and control valves are to be fixed in the open position.

4.6.6.10 For the purpose of supplying the system with water from shore, connections are to be provided suitably located on the port and starboard sides of the ship. Measures are to be taken to prevent unauthorized opening of connection pipes valves.

4.7 FIRE EXTINGUISHING SYSTEMS FOR SHIPS CARRYING DANGEROUS GOODS

4.7.1 For the protection of engine rooms, boiler rooms, pump rooms and any spaces containing special equipment (switchboards, compressors, etc.) for the refrigerant equipment, only permanently fixed systems using the following extinguishing agents are permitted:

.1 CO_2 (carbon dioxide);

.2 HFC-227ea (heptafluoropropane);

.3 IG-541 (52 per cent nitrogen, 40 per cent argon, 8 per cent carbon dioxide).

Other extinguishing agents are permitted only by agreement with the Register.

4.7.2 The extinguishing agent is to be routed and distributed in the space to be protected by means of a permanent piping system. Piping installed in the space to be protected and the reinforcements it incorporates are to be made of steel. This is not to apply to the connecting nozzles of tanks and compensators provided that the materials used have equivalent fire-retardant properties. Piping is to be protected against corrosion both internally and externally.

4.7.3 Triggering device of the system is to meet the following requirements:

.1 automatically activated fire extinguishing systems are not permitted;

.2 it is to be possible to activate the system from a suitable point located outside the space to be protected;

.3 triggering devices are to be so installed that they can be activated in the event of a fire and so that the risk of their breakdown in the event of a fire or an explosion in the space to be protected is reduced as far as possible.

Systems which are not mechanically activated are to be supplied from two power sources independent of each other. These power sources are to be located outside the space to be protected. The control lines located in the space to be protected are to be so designed as to remain capable of operating in the event of a fire for a minimum of 30 min. The electrical installations are deemed to meet this requirement if they conform to the IEC 60331-21:1999 standard.

When the triggering devices are so placed as not to be visible, the component concealing them is to carry the "Fire extinguishing system" symbol, each side being not less than 10 cm in length, with the following text in red letters on a white ground: "Fire extinguishing system";

.4 if the fire extinguishing system is intended to protect several spaces, it is to comprise a separate and clearly-marked triggering device for each space;

.5 the instructions are to be posted alongside all triggering devices and be clearly visible and indelible. The instructions are to be in a language the crew members can read and understand and if the language is not English, French or German, they are to be in English, French or German. They are to include the information concerning:

the activation of the fire extinguishing system;

the need to ensure that all persons have left the space to be protected;

the correct behaviour of the crew in the event of activation;

the correct behaviour of the crew in the event of the failure of the fire extinguishing system to function properly;

.6 the operating instructions are to mention that prior to the activation of the fire extinguishing system, combustion engines installed in the space and aspirating air from the space to be protected, are to be shut down.

4.7.4 In addition to the requirements of 4.5, the carbon dioxide system is to meet the following requirements:

.1 CO_2 cylinders are to be placed in a gastight space or cabinet separated from other spaces. The doors of such storage spaces or cabinets are to open outwards; they are to be capable of being locked and are to carry on the outside the symbols "Warning: danger", not less than 5 cm high, and "CO_2" in the same colours and the same size;

.2 storage cabinets or spaces for CO_2 cylinders located below deck are only to be accessible from the outside. These spaces are to have an artificial ventilation system with extractor heads and are to be completely independent of other ventilation systems on board;

.3 the opening of cylinder valves and the control of the valve discharging CO_2 into the space to be protected is to correspond to two different operations;

.4 the appropriate period of time mentioned in 5.17.2 is to be at least 20 s.

4.7.5 Fire-extinguishing systems using HFC-227ea (heptafluoropropane) is to meet the following requirements:

.1 where there are several spaces with different gross volumes, each space is to be equipped with its own fire extinguishing system;

.2 every tank containing HFC-227ea placed in the space to be protected is to be fitted with a device to prevent overpressure. This device is to ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire extinguishing system has not been brought into service;

.3 every tank is to be fitted with a device permitting control of the gas pressure;

.4 the level of filling of tanks is not to exceed 1,15 kg/l. The specific volume of depressurised HFC-227ea is to be taken equal to 0,1374 m^3/kg;

.5 the concentration of HFC-227ea in the space to be protected is to be not less than 8 per cent of the gross volume of the space. This quantity is to be released within 10 s;

.6 tanks of HFC-227ea are to be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of propellent gas. Where there is no wheelhouse, the alarm is to be triggered outside the space to be protected;

.7 after discharge, the concentration of HFC-227ea in the space to be protected is not to exceed 10,5 per cent (volume);

.8 the fire extinguishing system is not to comprise aluminium parts.

4.7.6 Fire extinguishing systems operating with IG-541 are to meet the following requirements:

.1 where there are several spaces with different gross volumes, each space is to be equipped with its own fire extinguishing system;

.2 every tank containing IG-541 placed in the space to be protected is to be fitted with a device to prevent overpressure. This device is to ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire extinguishing system has not been brought into service;

.3 each tank is to be fitted with a device for checking the contents;

.4 the filling pressure of the tanks is not to exceed 200 kg/cm^2 at a temperature of +15 °C;

.5 the concentration of IG-541 in the space to be protected is to be not less than 44 per cent and not more than 50 per cent of the gross volume of the space. This quantity is to be released within 120 s.

5 FIRE DETECTION AND ALARM SYSTEMS

5.1 Depending on the type and structural features of a ship, the ship's spaces are to be equipped with the following fire detection and alarm systems:

.1 automatic fire detection system;

.2 manually operated call points;

.3 warning alarms on bringing fire extinguishing systems into operation.

5.2 The fire detection and alarm system is to be of an approved type.

5.3 All electrical equipment, instruments and electric circuits of the systems are to comply with the requirements of Part IX "Electrical Equipment".

5.4 The following ships are to be equipped with automatic fire detection system:

passenger ships;

cargo ships 500 gross tonnage and over;

ships with unattended machinery spaces of category A.

5.5 Manually operated call points are to be provided on:

passenger ships;

oil tankers intended for the carriage of petroleum products with a flash point below 60 °C;

ships with two or more decks.

5.6 Warning alarms on bringing fire extinguishing systems into operation are to be installed in the spaces protected by the systems where personnel work or have access under normal operating conditions.

5.7 Ships fitted with fire detection system are to have main fire control stations located in the wheelhouse where all indicating units of the fire detection and alarm system are to be concentrated and switches of the system for announcing occurrence of a fire to passengers and crew.

5.8 On passenger ships where there are remote controlled doors in watertight bulkheads a signal on closing the doors is to be provided in the wheelhouse.

5.9 An automatic fire detection and alarm system is to be provided in the following spaces:

all spaces where passengers and crew are permanently present;

cargo spaces;

storerooms containing flammable materials;

galleys;

engine and boiler rooms with automated control of unattended machinery installation for ships with automation distinguishing mark in the class notation (refer to 1.1.1, Part X "Automation").

5.10 Each line with detectors of the automatic fire detection and alarm system is not to serve more than one fire zone and more than two decks located one above another.

5.11 Detectors of an approved type are to be used in the system. The detectors are to be fitted in the upper part of each protected space bounded by bulkheads and decks in such a way that a detector operate in whatever part of the space a fire occurred. Where the area of the space is less than 25 m^2 only one detector may be installed. Where the area of the space is larger two or more detectors are required depending on the characteristics of the detector, the space shape and size.

5.12 On passenger ships at least one manually operated call point is to be fitted within each main vertical zone on both sides of the ship on each deck in such a manner that a distance between neighbouring detectors is not more than 10 m.

Detectors are to be located in the following spaces:

corridors, lobbies, lifts;

dining-rooms, saloons with a square of more than 50 m^2;

machinery spaces, galleys and other fire hazardous spaces.

5.13 Detectors are to be located in easily accessible and conspicuous places, be painted red and protected against unauthorized operation.

5.14 General alarm system described in 7.3, Part IX "Electrical Equipment" is to be used for announcement of a fire to the crew, passengers and special personnel.

5.15 At mooring a fire detection signal is to be duplicated by a sound signal in the location with permanent watch.

5.16 In case of failure of the main power supply system, the fire detection and alarm system is to be automatically connected by a separate feeder to an emergency source of electrical power.

5.17 Alarm device.

5.17.1 Permanently fixed fire extinguishing systems are to be fitted with an audible and visual alarm device.

5.17.2 The alarm device is to be set off automatically as soon as the fire extinguishing system is first activated. The alarm device is to function for an appropriate period of time before the extinguishing medium is released; it is not to be possible to turn it off (refer also to 4.7.4.4).

5.17.3 Alarm signals are to be clearly visible in the spaces to be protected and their access points and be clearly audible under operating conditions corresponding to the highest possible sound level. It is to be possible to distinguish them clearly from all other sound and visual signals in the space to be protected.

5.17.4 Sound alarms are also to be clearly audible in adjoining spaces, with the communicating doors shut, and under operating conditions corresponding to the highest possible sound level.

5.17.5 If the alarm device is not intrinsically protected against short circuits, broken wires and drops in voltage, it is to be possible to monitor its operation.

5.17.6 A sign with the following text in red letters on a white ground is to be clearly posted at the entrance to any space the extinguishing agent may reach: "Warning, fire extinguishing system! Leave this space immediately when the ... (description) alarm is activated!".

6 FIRE-FIGHTING OUTFIT

6.1 All items of fire-fighting outfit are to be readily accessible and to be kept ready for use at any time.

6.2 Fire hoses, nozzles, fire extinguishers and sets of the fireman's outfit of approved types may be used.

6.3 Portable fire extinguishers of the standard type, which comply with the following requirements are to be used on ships:

.1 the capacity of portable fire extinguishers is to be:

from 9 to 13,5 l for liquid fire extinguishes;

mass of a fire extinguishing medium in powder fire extinguishers is to be not less than 5 kg;

carbon dioxide fire extinguishers are to contain not less than 3 kg of carbon dioxide. A lower content fire extinguisher is to be used for rooms with an area of less than 45 m^2. The content of these fire extinguishers is to be no more than 1 kg per 15 m^2 of the deck area.

On agreement with the Register, depending on the type and purpose of the ship and also on the size of the protected spaces fire extinguishers with other characteristics may be used;

.2 fire extinguishing medium, which either by itself or under the expected conditions of use gives off toxic gases in such quantities as to endanger persons is not allowed in fire extinguishers.

The use of carbon dioxide fire extinguishers in accommodation spaces is not allowed. In other spaces they are to be used in accordance with the requirements of the Administration and on special agreement with the Register;

.3 fire extinguishers are to have safety devices preventing rupture of fire extinguisher body in case of inadmissible pressure rise therein;

.4 a charged fire extinguisher mass is not to exceed 23 kg;

.5 a method of application is to be clearly indicated on each portable fire extinguisher.

6.4 Ship spaces are to be fitted with portable fire extinguishers in accordance with Table 6.4.

6.5 The location of hand portable fire extinguishers is to comply with the following requirements:

Table 6.4

Nos	Space	Type of fire extinguisher	Number of fire extinguishers for each space
1	Control stations	foam or powder	1 pc.[2]
2	Spaces containing electrical and radio equipment	carbon dioxide or powder	1 pc.
3	Machinery spaces with oil-fired main and auxiliary engines	foam or powder	1 pc. on ships with power output up to 110 kW, 2 pcs on ships with power output up to 750 kW, on ships with power output above 750 kW 1 pc. additionally for each 750 kW[2]
4	Boiler rooms with oil-fired main and auxiliary boilers	foam or powder	1 fire extinguisher for each boiler[2]
5	Galleys with oil-fired equipment	foam or powder	1 pc.[3]
6	Galleys with electrical or gas-fired equipment	carbon dioxide or powder	1 pc.[3]
7	Storerooms containing flammable and combustible materials	foam or powder	1 pc.[3]
8	Spaces containing generators of total power more than 200 kW	carbon dioxide or powder	1 pc. additionally to the outfit of the appropriate space
9	Spaces containing switchboards	carbon dioxide or powder	2 pcs. One more fire extinguisher additionally to the engine room outfit, in case the switchboard is located in the engine room
10	Cargo pump rooms and fuel oil distribution stations	foam or powder	1 pc.
11	Accommodation and service spaces	foam or powder	2 pcs[1, 2]
12	Insulated, heated or refrigerated spaces containing solid fuel, liquid oil- or liquitied gas-fired equipment	foam or powder	1 pc.[2]
13	Enclosed decks	foam or powder	1 pc. for each 20 m of corridor length
14	Open decks on passenger ships	foam or powder	1 pc. on each deck of up to 20 m long; 2 pc. on each deck of more than 20 m long
15	Open decks on other ships except oil tankers	foam or powder	1 pc. for ships of up to 20 m in length; 2 pc for ships of more than 20 m in length
16	Open decks on oil tankers	foam or powder	4 pcs in the area of cofferdams in the forward and aft parts of the ship
17	Open decks on ships intended for the carriage of dangerous goods	foam or powder	1 pc. additionally to that indicated in item 15 in the forward and aft parts of the open deck

[1] On passenger ships, in addition to the above, one fire extinguisher for each 120 m^2 of gross floor area in public spaces (dining-rooms, saloons etc.) and for each group of 10 cabins is to be provided.

[2] One of the fire extinguishers is to be powder-type with a content of at least 6 kg suitable for extinguishing fires of solids, gases and liquids as well as for fires in electrical equipment of up to 1000 V. Other portable extinguishers equivalent to the above mentioned and complying with the EN 3:1996 standard may be used.

[3] An additional portable powder extinguisher is to be provided on passenger ships.

.1 fire extinguishers are to be located in places protected against direct sunrays and precipitation at a height of not more than 1,5 m measured from the deck or flooring of the space to a fire extinguisher handle and at a distance of at least 1,5 m from heating appliances or other sources of heat;

.2 fire extinguishers are to be reliably secured in special brackets of a quick-detachable type;

.3 where several fire extinguishers are placed in spaces in compliance with Table 6.4, part of them is to be located near the entrances, and the remaining are to be located where a fire is most likely to break out in the space;

.4 where only one fire extinguisher is provided in the space, it is to be installed near the entrance to that space.

6.6 Metal receptacles with sand or dry sawdust impregnated with soda are to meet the following requirements:

.1 the capacity of the receptacles is to be not less than 100 litres;

.2 each receptacle is to be provided with a scoop, a readily opening cover and a device for holding the cover in the open position.

6.7 Metal receptacles with sand are to be installed in boiler rooms in the boiler front side, in way of the paint locker and in places of fuel oil supply and distribution.

Receptacles with sand are not allowed in engine and pump rooms. Receptacles containing dry sawdust impregnated with soda are to be used in such spaces.

6.8 One foam or powder portable fire extinguisher may be used in lieu of one receptacle with sand or sawdust.

6.9 Fire smothering blankets are to comply with the following requirements:

.1 they are to be sufficiently stout and durable;

.2 they are to be generally made of a non-combustible material (clean unraised thick felt may be used);

.3 they are to be at least 3 m^2 in area and to have a shape close to a square or a circle.

6.10 Blankets are to be stored in special easily opening cases or lockers.

6.11 Blankets are to be provided in the spaces where fuel oil is used.

On passenger ships blankets are to be additionally provided in the galleys as well as at the hairdresser's and other spaces where flammable liquids are stored.

6.12 Complete sets of fire-fighting tools are to comply with the following requirements:

.1 one complete set is to include one fire axe and one light-weight fire crowbar (1 pc. of each);

.2 sets of fire-fighting tools are to be located and secured on regular metal boards located in readily accessible places. The fastening of tools is to provide ready availability of the tools for use;

.3 boards and tools are to be painted red.

6.13 Fire buckets are to be provided with a hemp rope of a sufficient length and to be kept on open decks in wooden supports. Fire buckets are to be painted red and bear a fire fighting outfit marking approved by the Administration.

6.14 The fireman's outfit is to be approved by a competent body recognized by the Administration and is to consist of:

.1 a rigid helmet providing effective protection against impact;

.2 protective clothing of material to protect the skin from the heat radiating from the fire and from burns and scalding by steam. The outer surface is to be water-resistant;

.3 boots and gloves of rubber or other electrically non-conducting material;

.4 an electric safety lamp (hand lantern) with a minimum burning period of three hours;

.5 a fire axe with a helve made of hard wood. If the helve is made of some other material, it is to be insulated with some electrically non-conducting material;

.6 a self-contained compressed air-operated breathing apparatus, the volume of air contained in the cylinders of which is to be at least 1200 l, or other self-contained breathing apparatus which is to be capable of functioning for at least 30 min;

.7 a fireproof lifeline, about 30 m in length, capable of being attached by means of a snaphook directly to the apparatus or to a separate belt in order to prevent breathing apparatus becoming detached when the lifeline is operated.

6.15 The fireman's outfit sets are to be stored in widely separated places, to be easily accessible and ready for use.

6.16 Where fire-fighting arrangements are stowed in special lockers and recesses, a board or a door closing their storage places is to be painted red and be properly marked.

6.17 On ships intended for the carriage of petroleum products with a flash point below 60 °C as well as on tugs handling such ships two gas analyzers for vapours of flammable liquids and gas are to be provided.

6.18 On cabin ships there are to be at least four emergency escape breathing apparatus of an approved type.

6.19 Ships of inland navigation are to be provided with fire-fighting outfit in accordance with the standards given in Appendix.

7 FIRE PROTECTION OF SHIPS OF LESS THAN 25 M IN LENGTH

7.1 GENERAL

7.1.1 The requirements of the present Section apply to structural fire protection and active means of fire fighting on board ships of less than 25 m in length.

7.1.2 The requirements set forth in Sections 1 to 6 of the present Part are applicable to ships of less than 25 m in length as far as practicable and reasonable.

7.2 STRUCTURAL FIRE PROTECTION

7.2.1 On wooden and composite ships wood without fire-resistant impregnation may be used for interior bulkheads, enclosures and decks, except for wooden constructions in the space where internal combustion engines are installed.

Ceilings, sides and bulkheads in machinery spaces are to be covered with a non-combustible insulation layer and sheathed with steel sheets, the requirement of 2.3.2 being complied with.

7.2.2 On open undecked ships the engines are to be covered with detachable housings of non-combustible material.

7.2.3 Where oil- or solid fuel-fired galley range is installed on a wooden deck or plating, the requirement of 3.1.3 is to be met. The insulated surface may, in this case, project beyond the range for 250 mm.

7.2.4 The distance from the galley range to constructions made of combustible materials protected with non-combustible heat insulation may be reduced to 150 mm. The insulation is to be at least 25 mm thick.

7.2.5 A gas-fired appliance and a gas cylinder may be located in the same space; they may be connected with a flexible hose made of an approved material.

7.2.6 Draught-stops not less than 150 mm in size on either side are to be provided in places where uptakes pass through wooden decks and bulkheads. Wooden constructions abutting on draught-stops are to be insulated by roof steel on a layer of non-combustible materials of at least 10 mm thick.

7.2.7 For filling fuel oil tanks pipe branches are to be led out to the deck to prevent fuel oil from penetration inside the hull. Plugs of pipe branches are to be made either of metal precluding spark formation or of a non-combustible material resistant to the effect of fuel oil and does not absorb it.

7.2.8 On ships with a continuous deck a fuel oil tank is to be located in a compartment (recess) separated from the engine room and provided with natural ventilation for removal of fuel oil vapours.

7.2.9 On undecked ships without a separate room for main engines, fuel oil tanks are to be placed at a distance of at least 800 mm from the engine and exhaust-gas pipes. In such case, the engines are to be enclosed with detachable plates. Ventilation of the space in the area of fuel oil tanks, fittings of pipes and installation of trays are to be similar to the case for arrangement of tanks in separate compartments.

7.2.10 The deck above fuel oil tanks compartment is to have non-combustible insulation.

7.2.11 Air pipes going from the fuel oil tank and from the compartment are to be separate. Pipe outlets are to be as widely separated as possible and to be provided with ejector heads with flame-arresters. The height of the petrol tank pipe is to be such that petrol is not poured out during ship motions.

7.2.12 The tank fuel oil level indicator is to be of an explosion-proof design.

7.2.13 Connections of the petrol pipe are to have no gaskets. The petrol pipe is to be laid in easily accessible places and be protected against physical damage.

7.2.14 Where engines are installed in closed spaces the inlet of carburetor suction pipe is to be positioned at a distance of at least 300 mm above the cylinder covers and be fitted with a flame-arresting gauze. Where there are no suction pipes at the air inlet to the carburetor, flame-arresters are to be provided.

7.2.15 Ventilation pipes of at least 80 mm in diameter are to be fitted on the detachable housings of engines, one of the pipes is to end 70 mm above the ship's hull bottom and the other is to terminate at the housing cover.

7.2.16 Suction pipes of carburetors are to project beyond the detachable housings and to project above them for at least 500 mm. The ends of suction pipes are to be provided with heads with flame-arresters.

7.2.17 All components of the fuel oil system are to be located on the engine side opposite to the exhaust-gas manifold.

7.3 FIRE-FIGHTING ARRANGEMENTS

7.3.1 In spaces containing internal combustion engines it is enough to have one fire hydrant placed directly at the fire pimp.

7.3.2 One jet of water may be delivered on ships other than passenger ships, pushers and oil tankers.

7.3.3 On ships provided with the foam smothering system, a foam concentrate may be delivered into the suction space of the fire pump.

7.3.4 The water for the fire pump may be taken from one sea valve.

7.3.5 The piping of the water fire main system may be made of pipes without corrosive-resistant coating.

7.3.6 On ships of less than 12 m in length, one foam or powder fire-extinguisher complying with the requirements of 6.3 may be used instead of fixed fire-fighting systems.

7.4 FIRE-FIGHTING OUTFIT

7.4.1 Ships of less than 25 m in length are to be provided with fire-fighting outfit in compliance with the standards given in Table 6.4 and Appendix. It is allowed to use:

.1 powder and carbon dioxide fire extinguishers with a charge mass not less than 1,4 kg; foam fire extinguishers with a capacity of at least 3,5 l;

.2 a receptacle with sand or sawdust impregnated with soda at least 0,05 m^3 in capacity, instead of which an extra fire extinguisher may be provided;

.3 fire smothering blankets $1{,}0 \times 1{,}5$ in size.

7.4.2 The length of fire hoses is to be at least 10 m.

7.4.3 Fire hose nozzles may be of 12 mm in diameter.

APPENDIX

TABLE OF STANDARDS FOR SUPPLYING FIRE-FIGHTING EQUIPMENT AND OUTFIT FOR INLAND NAVIGATION SHIPS

Nos	Type of ship	Mechanical fire pumps (pcs)		Blankets (pcs)	Fire tools (pcs)	Fire bucket (pcs)	Fireman's outfit (sets)
		main	emergency				
1	2	3	4	5	6	7	8
I	Passenger ships						
1	Under 30 m in length	1	1	1[4]	1	2	2
2	30-65 m	1	1	1[4]	2	8	2
3	65-100 m	1	1	2[4]	4	12	2
4	over 100	2	1	3[4]	6	15	3
II	Oil tankers carrying vehicles with fuel oil in tanks and packaged highly flammable liquids						
5	Under 30 m in length	1	—	2	1	2	—
6	30-65 m	1	—	3	1	4	2
7	65-100 m	1	—	4	2	4	2
8	over 100 m	1	1	4	2	4	3
III	Other ships						
9	Under 30 m in length	1[2]	—	1	1[3]	2	—
10	30-65 m	1	—	1	1	4	—
11	65-100 m	1	—	2	2	8	1[1]
12	over 100 m	1	—	2	2	8	1[1]

[1] For ships with passenger berths and ships with two and more decks.
[2] A motor pump (refer to 7.1.2) or another fire extinguishing means may be used on ships with engine power output under 110 kW, on agreement with the Register.
[3] A set of fire tools may be omitted on service boats with the engine capacity of 165 kW.
[4] Refer to 6.11.

PART VI. MACHINERY INSTALLATIONS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to ship machinery installations, equipment of machinery spaces, shafting lines, propellers and active means of the ship's steering (AMSS).

1.1.2 The requirements of the present Part are set forth proceeding from the condition that the flash point of fuel oil (refer to 1.2, Part V "Fire Protection") used for engines and boilers is not below 55 °C and the flash point for emergency diesel-generators is not below 43 °C.

1.1.3 Petrol engines are allowed:

on launches and life boats;

to drive portable fire and drain pumps (except for oil tankers and ships carrying highly flammable liquids).

1.1.4 For the classification of machinery installations of inland navigation ships by the Register, the requirements of Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships apply, as far as applicable for inland navigation ships.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to general terminology of the Rules are given in Part I "Classification".

The following definitions, adopted in the present Part, are also applicable for the purpose of Part VII "Systems and Piping" and Part VIII "Machinery".

Auxiliary active means of the ship's steering is a propulsion and steering unit ensuring propulsion and steering of the ship at low speed or steering of the ship at zero speed when the ship is equipped with main means of propulsion and steering, and is used either in combination with the latter or when the main means of propulsion and steering are inoperative.

Auxiliary machinery is the machinery necessary for the operation of main machinery, supply of the ship with electric power and other kinds of power, as well as functioning of systems and arrangements subject to the Register survey.

Among the essential auxiliary machinery are:

generating set used as the main source of electric power;

steam supply source;

condenser pump and arrangements used to maintain vacuum in condensers;

forced draft blowers of boilers;

air compressor with air receiver intended for starting or control;

as well as machinery necessary for operation or functioning of:

boiler feed water system;

fuel oil systems of boilers or engines;

arrangements to supply water under pressure;

hydraulic, pneumatic or electric control systems of main machinery, including controllable pitch propellers.

Exit is an opening in bulkhead or deck provided with closing means and intended for the passage of people.

Means of escape are escape routes leading from the lowest part of the machinery space floor plates to the exit from that space.

Main engine room is a space where the main machinery is installed.

Main active means of the ship's steering is a propulsion and steering unit ensuring propulsion and steering of the ship under all running conditions as well as steering of the ship at zero speed (with no longitudinal component of propeller thrust or tractive force).

Main machinery is the machinery being part of the propulsion plant.

Remote control is the changing of the speed and direction of rotation as well as starting and stopping of the machinery from a remote position.

Engine room is a space where auxiliary internal combustion engines are installed.

Machinery spaces are all machinery spaces of category A and all other spaces containing main machinery, shafting, boilers, fuel oil units, steam and internal combustion engines, generators and other major electrical machinery, fuel oil filling stations, ventilation and air-conditioning installations, refrigerating plants, steering engines, stabilizing equipment and similar spaces, and trunks to such spaces.

Machinery spaces of category A are those spaces and trunks to such spaces which contain:

internal combustion engines used as main machinery;

internal combustion engines used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW;

oil-fired boilers and fuel oil units.

Local control station is a control station fitted with controls, indicators, means of communication (if necessary) intended for control, located in proximity to, or directly on, the machinery.

Torsional vibration stresses are stresses resulting from the alternating torque which is superimposed on the mean torque.

Dead ship condition (as well as power failure) is the condition under which the main machinery and boilers, their related auxiliaries and equipment are not in operation due to absence of power. Besides, there is lack of power to put the main machinery in operation. At the same time it is assumed that there are healthy main source of electric power and other essential auxiliaries.

Equipment comprises all types of filters, heat exchangers, tanks and other arrangements necessary for normal operation of the machinery installation.

Common control station is a control station intended for simultaneous control of two or several main engines and fitted with indicating instruments, alarm devices and means of communication.

Cargo control room (CCR) is a room or part thereof where control, monitoring means and alarm devices, related to performance of cargo handling operations are located; and on tankers, in addition, means for monitoring and alarm for cargo, ballast atmosphere parameters of cargo and ballast tanks and cargo pump rooms as well as discharge of oily and flushing water.

Propulsion plant is the totality of machinery and arrangements intended for generating, converting and transmitting power ensuring propulsion of the ship at all specified rates of speed and comprising propellers, shafting, main gearing and main machinery.

Rated power means the maximum continuous (not time-limited) power adopted in calculations under the Rules and stated in documents issued by the Register.

Rated rotation speed means the rotation speed corresponding to the rated power.

Technical condition monitoring system is a complex of inspection facilities and actuators interacting with the control item on demand set forth by the appropriate documentation. The technical condition monitoring system provides for the identification of the type of the item technical condition and systematic observation (tracing) of its change on the basis of measurement of the controlled (diagnostic) parameters and comparison of these values with the set standards (refer also to Section 11, Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships).

Active means of the ship's steering (AMSS) are special propulsion and steering units and any combination of them or with the main propulsion devices, capable of producing thrust or traction force both at a fixed angle to the centre line plane of the ship and at a variable angle, either under all running conditions or part thereof, including low and zero speed.

The AMSS comprise steerable propellers including tiltable and rectractable units, propulsion systems of active rudders, vertical-axis propellers, water-jets, propellers in transverse tunnel (athwartship thrusters) and other similar devices.

Fuel oil unit is any equipment used for the preparation and delivery of fuel oil (heated or unheated) to boiler, inert gas generator or engine (including gas turbines) and includes fuel oil pumps, separators, filters and heaters at a pressure of more than 0,18 MPa.

Fuel oil transfer pumps are not considered as fuel oil units.

Main machinery control room is a space containing the remote controls of main and auxiliary machinery, CP-propellers, main and auxiliary AMSS, indicating instruments, alarm devices and means of communication.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions covering the procedure of classification, technical supervision during ship construction and surveys as well as the requirements for technical documentation submitted to the Register for review and approval are given in General Regulations for the Classification and Other Activity, in Part II "Technical Documentation" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships and in Part I "Classification" of the present Rules.

1.3.2 Subject to the Register technical supervision, including the approval of technical documentation according to 4.1.7, Part I "Classification", are the following items and products:

.1 shafting as assembled, including propeller shafts with liners and waterproof coatings, shaft bearings, thrust blocks and sterntube bearings as assembled, couplings, sterntube seals;

.2 propellers, including vertical-axis propellers and water-jets, steerable propellers, athwartship thrusters and propulsive systems of active rudders, pitch control units, oil distribution boxes and control systems of propellers;

.3 items indicated in Table 1.3.2.3.

Table 1.3.2.3

Items to be supervised

Nos	Item	Material	Chapter of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships
1	**Shafting**		
1.1	Intermediate, thrust and propeller shafts	Forged steel	3.7
1.2	Propeller shaft liners	Copper alloy Corrosion-resistant steel	4.1 On agreement with the Register
1.3	Half-couplings	Forged steel Cast steel	3.7 3.8
1.4	Coupling bolts	Forged steel	3.7
1.5	Sterntubes	Rolled steel Cast steel Forged steel Cast iron	3.2 3.8 3.7 3.9
1.6	Sterntube and strut bushes	Cast steel Copper alloy Forged steel Cast iron	3.8 4.2 3.7 3.9, 3.10
1.7	Structure and lining of sterntube bearings	Non-metallic materials Metal alloys	On agreement with the Register
1.8	Thrust block casing	Rolled steel Cast steel Cast iron	3.2 3.8 3.9
2	**Propellers**		
2.1	Solid propellers	Cast steel Copper alloy	3.12 4.2
2.2	Built propellers		
2.2.1 **2.2.2**	Blades Boss	Cast steel Copper alloy	3.12 4.2
2.2.3	Bolts (studs) for securing of blades, hub cones and seals	Copper alloy Forged steel	4.1 3.7
2.3	Hub cones	Cast steel Copper alloy	3.12 4.1, 4.2

Notes: 1. Materials are to be chosen in accordance with 2.3.
2. Propeller, thrust and intermediate shafts, propeller blades are to be subjected to non-destructive tests when manufactured. The methods, scope and standards of such tests are to be agreed with the Register.
3.The list of components and materials used for the items of CP-propellers (crankpin rings, crossheads, push-pull rods, hydraulic cylinders, etc.), as well as those of AMSS are subject to special consideration by the Register in each case.

1.3.3 Subject to the Register technical supervision is the assembling of the machinery space equipment and testing of the following components of the machinery installation:

.1 main machinery with reduction gears and couplings;

.2 boilers, heat exchangers and pressure vessels;

.3 auxiliary machinery;

.4 control, monitoring and alarm systems of the machinery installation;

.5 shafting and propellers;

.6 active means of the ship's steering.

1.3.4 After assembling of machinery, equipment, systems and piping arrangements on board the ship, the machinery installation is to be tested in operation under load according to the program approved by the Register.

2 GENERAL

2.1 POWER OF THE MAIN MACHINERY

2.1.1 The power of the main machinery is to provide the speed of the ship under loaded condition (or of a push-ship with loaded pushed train) of at least 12 km/h in calm water and of at least 6 km/h when the ship moves upstream the river with regard to the intended area of navigation.

2.1.2 The machinery installation is to provide sufficient astern power to maintain manoeuvring of the ship under all normal service conditions. The "normal service conditions" mean henceforward specified (non-emergency) service conditions of the machinery installation and the ship (considering the provisions of 2.2).

2.1.3 The machinery installation is to be capable of maintaining in free route astern at least 70 per cent of the rated rotation speed for a period of at least 30 min.

The astern power is to be sufficient to take way off the ship making a full ahead speed on an agreeable length, which is to be confirmed during trials. The agreeable length means the stopping distance of the ship agreed between the Designer and the Customer, determined according to the purpose, structure and service conditions of the ship.

2.1.4 In machinery installations with reversing gears or CP-propellers as well as in electric propulsion plants, route astern is not to cause overload of main machinery in excess of permissible values.

2.1.5 The machinery installation with one main internal combustion engine in case of failure of one turbocharger (refer to 2.5.1, Part VIII "Machinery") is to provide the ship's speed at which steerability of the ship is maintained.

2.1.6 In sound cases, the minimum values of power may be reduced. Such cases are subject to special consideration by the Register.

2.1.7 For ships with twin hulls, the failure of the machinery installation of one hull is not to put the machinery installation of the other hull out of action.

2.1.8 In addition to the main propulsion system, ships are to be equipped with a second independent propulsion system so as to ensure that, in the event of a breakdown affecting the main propulsion system, the ship can continue to make steerageway under its own power.

The second independent propulsion system is to be placed in a separate engine room.

If both engine rooms have common partitions, these are to be constructed according to Section 2, Part V "Fire Protection".

2.2 ENVIRONMENTAL CONDITIONS

2.2.1 Machinery, equipment and systems installed on board the ship are to remain operative under all normal service conditions of the ship as well as under steady heel up to and including 10°, either way, and/or under steady trim up to and including 5° by bow or stern (without considering the constructional trim) unless provided otherwise in other Parts of the Rules.

2.2.2 In calculation of the machinery installation and auxiliary equipment the following values are generally assumed:

sea water temperature — +20 °C;

air temperature in the machinery space — +40 °C.

On agreement with the Register, in some cases other temperatures may be adopted.

2.3 MATERIALS AND WELDING

2.3.1 Materials for the manufacture of shafting and propellers items are to comply with the requirements of the relevant Chapters of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships, as indicated in column 4 of Table 1.3.2.3 of the present Part. The materials used for shafting items stated under 1.7 of Table 1.3.2.3, are chosen in accordance with standards. The materials used for items stated under 1.2 to 1.6, 1.8, 2.2.3 and 2.3 of Table 1.3.2.3, may also be chosen in accordance with the relevant standards. In this case the application of materials is to be agreed with the Register when considering technical documentation.

Materials used for items (semi-finished products) indicated under 1.1, 2.1, 2.2.1 and 2.2.2. of Table 1.3.2.3, are to be manufactured under the Register technical supervision; technical supervision of materials used for other items listed in the said Table may be required at the Register discretion.

2.3.2 Intermediate, thrust and propeller shafts are generally to be made of steel with tensile strength R_m between 400 and 800 MPa.

2.3.3 Mechanical properties and chemical composition of materials used for the manufacture of propellers are to comply with the requirements of 3.12 and 4.2, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

2.3.4 Where alloy steel, including corrosion-resistant and high strength steel, is used for the manufacture of shafting and propellers, information on chemical composition, mechanical and special properties, confirming suitability of the steel for the intended application, are to be submitted to the Register.

2.3.5 Intermediate, thrust and propeller shafts as well as coupling bolts (studs) may be manufactured of rolled steel in accordance with 3.7.1.3, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

2.3.6 Securing and locking items of propeller blades, hub cones, sterntubes, sternbushes and sealings are to be made of corrosion-resistant materials.

2.3.7 The use of materials other than those indicated in 2.3.2, 2.3.4 to 2.3.6 for the manufacture of shafts and shafting items is subject to special consideration by the Register.

2.3.8 On agreement with the Register, plastics and other non-metallic materials may be used for the manufacture of items indicated under 1.2, 1.6, 2.1, 2.2.1 and 2.3 of Table 1.3.2.3.

2.3.9 Welding and non-destructive testing of welded joints are to comply with the requirements of Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

2.4 INDICATING INSTRUMENTS

2.4.1 All indicating instruments, except for liquid-filled thermometers, are to be checked by competent bodies.

Pressure gauges fitted on boilers, heat exchangers, pressure vessels and refrigerating plants are to meet the requirements of 3.3.5 and 6.3.9, Part X "Boilers, Heat Exchangers and Pressure Vessels" and 7.1, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships, respectively.

2.4.2 Tachometers accuracy is to be within $\pm 2,5$ per cent. With restricted rotation speed ranges, the accuracy is not to be below $\pm 2,0$ per cent, and the ranges are to be marked with bright colour on the scales of tachometers or in another way.

2.5 VIBRATION AND NOISE

2.5.1 Where necessary, the appropriate measures are to be taken to insure that the noise and vibration produced by machinery and equipment have no harmful effect upon people and do not impair the normal operation of the ship.

2.5.2 Under normal service conditions of engines, the level of noise produced by the ship while running is not to exceed 75 dB(A) at a distance of 25 m from the ship.

2.6 SPARE PARTS

2.6.1 The nomenclature and amount of spare parts, tools, indicating instruments and materials for the maintenance and repair of machinery equipment are not regulated.

3 CONTROL DEVICES AND STATIONS. MEANS OF COMMUNICATION

3.1 CONTROL DEVICES

3.1.1 Main and auxiliary machinery essential for the propulsion, control and safety of the ship are to be provided with effective means for its operation and control. All control systems essential for the propulsion, control and safety of the ship are to be independent or so designed that failure of one of them does not degrade the performance of the other.

3.1.2 Starting and reversing arrangements are to be so designed and placed that each engine can be started or reversed by one operator. The force applied to the handle in this case is not to exceed 160 N.

3.1.3 The duration of reversing (a period of time from the reversing of a steering control to the beginning of the propeller operation with a thrust opposite in direction) is not to exceed:

25 s at full speed;

15 s at low speed,

depending on the ship's speed.

3.1.4 The proper working direction of control handles or handwheels is to be clearly indicated by arrows and relevant inscriptions.

3.1.5 The setting of manoeuvring handles of the main machinery from, or to the right of, the operator, or turning the handwheel clockwise, at control stations at the navigating bridge, are to correspond to the ahead speed direction of the ship.

In case of control stations from which only the stern is visible, such setting is to correspond to astern speed direction of the ship.

3.1.6 Control arrangements are to be so designed as to eliminate the possibility of spontaneously changing the positions prescribed.

3.1.7 Control devices of the main machinery are to have an interlocking system to preclude starting of the main machinery, with a shaft-turning gear engaged.

3.1.8 In case where in addition to the mechanical starting, manual drive of the machinery is provided, such manual drive is to be automatically disengaged when power drive is actuated and have interlocking system to preclude starting with the machinery at work.

3.1.9 It is recommended to provide an interlocking system between the engine-room telegraph and the reversing and starting arrangements so as to prevent the machinery from running in the direction opposite to the prescribed one.

3.1.10 The main machinery remote control system, with control from the navigating bridge, is to be designed so as to provide an alarm in case of failure. In case of push-ships, the alarm system is to be provided on the navigating bridge (in wheelhouse), in the engine room and in the accommodation spaces for engine-room personnel (refer also to 3.10.11). If possible, the prescribed propeller rotation speed and thrust direction are to remain unchanged until control is transferred to the local station. Among other factors, the loss of power supply (electric, pneumatic or hydraulic power) is not to substantially affect the power of main machinery or change the direction of propeller rotation.

3.10.11 The main machinery remote control from the navigating bridge is mandatory for push-ships, except for those operating only on roads or in ports.

3.2 CONTROL STATIONS

3.2.1 The navigating bridge control stations of the main machinery and propellers, as well as main machinery control room, with any type of remote control, are to be equipped with:

.1 controls for the operation of the main machinery and propellers. For installations comprising CP-propellers, vertical-axis and similar type propellers, the navigating bridge may be equipped with means for remote control of propellers only. In such case, the alarm for low pressure of starting air, in compliance with 3.2.1.10, may be omitted;

.2 propeller shaft rotation speed and direction indicators if a fixed pitch propeller is installed; propeller shaft rotation speed and blade position indicators if the controllable pitch propeller is installed; the main machinery rotation speed indicator if the disengaging clutch is installed;

.3 indication to show that the main machinery and remote control systems are ready for operation;

.4 indication to show which station is in control of the main machinery;

.5 means of communication in accordance with 3.3;

.6 main machinery emergency shut-down device, independent of the control system.

If disengaging clutches are provided for disconnection of main machinery from propellers, it is allowed to provide emergency disengagement only of these clutches at the navigating bridge control stations;

.7 device to override the automatic protection covering full range of parameters except for those parameters which being exceeded, may result in serious damage, complete failure or explosion;

.8 indication for the override operation, alarms for activation of protection devices and emergency shut-down;

.9 alarm for the minimum pressure in pitch control system; overload alarm where the main machinery operates with a CP-propeller, if the recommendation of 6.5.3 is not fulfilled;

.10 alarm for low starting air pressure, set at a level permitting three starting attempts of reversible main engines duly prepared for operation;

.11 device for remote shut-off of fuel oil supply to each engine for multi-engine installations in case when the fuel oil is supplied to all engines of the installation from a common source.

3.2.2 Control stations on the bridge wings are to be equipped with devices of waterproof construction with controlled illumination. Control stations on the bridge wings may not meet the requirements of 3.2.1.3, 3.2.1.5, 3.2.1.7 to 3.2.1.10.

3.2.3 The emergency shut-down devices of the main machinery and the overrides of protection arrangements are to be so constructed as to preclude inadvertent operation thereof.

3.2.4 For the installations which consist of several main engines driving a single shaft, a common control station is to be provided.

3.2.5 With a remote control system in use, provision is also to be made for local control stations of the main machinery and propellers. The main engine control station is to be equipped with instruments in accordance with the requirements of 2.12.1, Part VIII "Machinery".

Where mechanical linkage is fitted for remote control, local control stations may be omitted on agreement with the Register.

3.2.6 Remote control of main machinery and propellers is to be performed only from one control station. The transfer of control between the navigating bridge and engine room is to be possible only from the engine room or the main machinery control room. Transfer devices are to be so designed as to prevent the propelling thrust from altering significantly.

3.2.7 The main machinery is to be operated remotely from the wheelhouse by means of a single control for each propeller. The requirement of 8.8.8. is to be met.

In installations with CP-propellers, systems with two control elements may be used.

3.2.8 The main machinery operation modes assigned from the wheelhouse are to be indicated at the main machinery control room, if any, and at the local control stations of the main machinery.

3.3 MEANS OF COMMUNICATION

3.3.1 At least two independent means are to be provided for communicating orders from the navigating bridge to the position in the machinery space or in the control station from which the rotation speed and direction of thrust of propellers are normally controlled.

One of these means is to be an engine-room telegraph which provides visual indication of orders and responses both in machinery spaces and on the navigating bridge and which is fitted with a sound signal clearly audible in any part of the machinery space while the machinery is at work, and distinct in tone from all other signals in that machinery space.

The appropriate means of communication are to be provided between the navigating bridge, machinery space and any other position from which the rotation speed or direction of thrust of propellers may be controlled.

A single voice-communication device serving two control stations located in close proximity is allowed.

3.3.2 Two-way communication is to be provided between the engine room, auxiliary machinery spaces and boiler room.

3.3.3 When voice-communication devices are installed, measures are to be taken to ensure clear audibility with the machinery at work.

3.3.4 For ships with twin hulls, provision is to be made for sound communication between local control stations of each hull in addition to communication between local control stations and the common control station in the wheelhouse and in the main machinery control room.

4 MACHINERY SPACES, ARRANGEMENT OF MACHINERY AND EQUIPMENT

4.1 GENERAL

4.1.1 Ventilation of machinery spaces is to comply with the requirements of 11.4, Part VII "Systems and Piping".

4.1.2 It is recommended to equip machinery and working spaces with heating arrangements.

4.2 ARRANGEMENT OF MACHINERY AND EQUIPMENT

4.2.1 Machinery, boilers, equipment, pipelines and fittings are to be so placed as to be readily accessible and safe for operation, dismantling and maintenance; the requirements of 4.5.1 are also to be met.

4.2.2 Boilers are to be arranged so as the distance between boilers and fuel oil tanks is sufficient for a free circulation of air necessary to keep the temperature of fuel oil in tanks below its flash point except cases specified in 12.3.8, Part VII "Systems and Piping".

4.2.3 Where auxiliary boilers are installed in the same space with internal combustion engines, their furnaces are to have metallic screens or other arrangements to protect the equipment of that space if flame is accidentally blown out from the furnace.

4.2.4 Auxiliary oil-fired boilers installed on platforms or intermediate decks in non-watertight enclosures are to be protected by oil-tight coamings at least 200 mm in height.

4.2.5 Driving machinery of pumps and fans in cargo pump rooms of oil tankers and combination carriers designed for the carriage of oil products with a flash point 60 °C or less and of oil recovery ships is be installed in spaces fitted with mechanical ventilation and having no exits leading to cargo pump rooms.

Driving machinery of submerged pumps are allowed to be installed on the open deck, provided their design and location comply with the requirements of 19.2.4.1.4 and 19.2.4.9, Part IX "Electrical Equipment".

Steam engines with working temperatures not exceeding 220 °C and hydraulic motors may be installed in cargo pump rooms.

Drive shafts of pumps and fans are to be carried through bulkheads or decks in gastight sealing glands supplied with effective lubrication from outside the pump room. As far as practicable, the sealing gland construction is to protect it against being overheated.

Those items of the gland which may come in contact in case of eventual disalignment of the drive shaft, or damage to bearings, are to be made of materials excluding spark formation.

If bellows are incorporated in the design, they are to be subjected to test pressure.

Cargo, ballast and stripping pumps installed in cargo pump rooms and having a drive shaft carried through bulkheads of the cargo pump room are to be provided with temperature sensing devices for the bulkhead shaft glands, pump bearings and casings.

Alarm is to be initiated in the cargo control room or the pump control station.

4.2.6 On ships carrying dangerous goods, the main and auxiliary combustion engines are to be located outside the cargo area. Entrances and other openings of engine rooms are to be at a distance of not less than 2 m from the cargo area.

4.2.7 Air compressors are to be installed in such places where air is least contaminated by vapours of combustible liquids.

4.2.8 Fuel oil units (refer to 1.2) as well as hydraulic units containing flammable liquids with working pressure above 1,5 MPa and not being a part of the main and auxiliary machinery, boilers, etc., are to be placed in separate spaces with self-closing steel doors.

If it is impracticable to locate such units in separate spaces, shielding of their main components and containment of possible leakages is to be provided.

4.2.9 Requirements for the arrangement of emergency diesel-generators are given in 9.2, Part IX "Electrical Equipment".

4.2.10 On oil recovery ships internal combustion engines, boilers and equipment containing sources of ignition as well as the relevant air inlets are to be installed in intrinsically safe spaces and areas (refer to 19.2, Part IX "Electrical Equipment").

4.2.11 On oil tankers entrance doors, air intakes and openings to accommodation and service spaces, control stations and machinery spaces are not to lead to the cargo area. They are to be located in the transverse bulkhead not facing the cargo area or on the side of the superstructure or deckhouse at a distance equal, at least, to 4 per cent of the ship’s length, but not less than 3 m from the end of the transverse bulkhead of the superstructure or deckhouse facing the cargo area.

4.3 ARRANGEMENT OF FUEL OIL TANKS

4.3.1 In general, fuel oil tanks are to be integral part of the ship's structure and are to be located outside machinery spaces of category A. Where fuel oil tanks, other than double bottom tanks, are necessarily located adjacent to or within machinery spaces of category A, their surfaces in machinery spaces are to be kept to a minimum and are to preferably have common boundary with double bottom tanks. Where such tanks are located within the boundaries of machinery spaces of category A, they are not to contain fuel oil having flash point less than 55 °C. In general, the use of free standing fuel oil tanks is to be avoided.

Service fuel oil tanks are to comply with the requirements of 12.8.1, Part VII "Systems and Piping".

4.3.2 Where the use of free standing fuel oil tanks is allowed by the Register, they are to be placed in oil-tight spill trays, and on passenger ships and special purpose ships carrying more than 50 special personnel, outside machinery spaces of category A as well.

4.3.3 Fuel oil tanks may be located above engines, boilers, turbines or other equipment with surface temperature under insulation over 220 °C only if adequate spill trays are provided below such tanks and the tanks are protected against heat radiation.

4.4 INSTALLATION OF MACHINERY AND EQUIPMENT

4.4.1 The machinery and equipment constituting the propulsion plant are to be installed on strong and rigid seatings and securely attached thereto. The construction of seatings is to comply with the requirements of 2.11, Part II "Hull".

4.4.2 Boilers are to be installed on bearers in such a way that their welded joints do not rest on the bearers supports.

4.4.3 To prevent shifting of boilers, provision is to be made for efficient stops and securing for rough sea; thermal expansion of boiler structures is to be provided.

4.4.4 The main machinery, their gears, thrust bearings of shafts are to be secured to seatings with fitted bolts throughout or in part. The appropriate stops may be used instead of the bolts. Where necessary, fitted bolts are to be used to fasten auxiliary machinery to seatings.

4.4.5 The bolts securing the main and auxiliary machinery and shaft bearings to their seatings, end nuts of shafts as well as bolts connecting the lengths of shafting are to be fitted with the appropriate lockers against spontaneous loosening.

4.4.6 Where the machinery is to be mounted on shock absorbers, the design of the latter is to be approved by the Register.

Shock absorbing fastenings of the machinery and equipment are to:

retain vibration-proof properties when the absorbed machinery and equipment are operated in the environmental conditions according to the requirements of 2.3.1;

be resistant to the attack of corrosive media, effects of temperatures and various kinds of radiation;

be equipped with a yielding grounding jumper of sufficient length to prevent radio reception interference and comply with the requirements of safety engineering;

eliminate the interference for operation of other equipment, devices and systems.

4.4.7 Installation of machinery on plastic pads is subject to special consideration by the Register in each case. Polymeric materials used for the pads are to comply with the requirements of 6.5, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

4.4.8 The machinery for driving generators is to be mounted on the same seatings as the generators.

4.5 MEANS OF ESCAPE FROM MACHINERY SPACES

4.5.1 The main and auxiliary machinery is to be so arranged in machinery spaces as to provide passageways from their control stations and service flats to the means escape from these spaces. The width of passageways is not to be less than 600 mm over the whole length.

On ships of less than 1000 gross tonnage the width of passageways may be reduced to 500 mm.

The width of passageways along the switchboards is to comply with the requirements of 4.6.7, Part IX "Electrical Equipment".

4.5.2 The width of ladders serving as means of escape and the width of exit doors are to be at least 600 mm. The width of ladders on ships of less than 1000 gross tonnage may be reduced to 500 mm.

4.5.3 Every machinery space of category A, shaft tunnels and pipe ducts are to have at least two means of escape which provide access to the appropriate lifeboat and liferaft embarkation decks.

Each of the two means of escape are to consist of steel ladders, as widely separated as possible, leading to exit doors from the spaces.

Fire-protection of these ladders from fire is to comply with the requirements of Part V "Fire Protection".

One of the means of escape may lead through a steel door capable of being operated from either side and fitted in the lower section of the space reasonably apart from the other ladder, which provides access to the safe means of escape leading from the lower section of the space to the open deck.

Exits from shaft tunnels and pipe ducts are to be enclosed in watertight trunks carried to above the margin line. One of these exits may lead to machinery spaces.

On oil tankers and combination carriers one of the means of escape from pipe ducts located below cargo tanks may lead to the cargo pump room. Exit to machinery spaces is not allowed.

Doors from shaft tunnels and pipe ducts leading to machinery spaces and cargo pump rooms are to comply with the requirements of 9.6, Part III "Equipment, Arrangements and Outfit".

Lifts are not to be considered as means of escape.

4.5.4 The second means of escape may be dispensed with if:

the total floor area of the machinery space does not exceed 35 m^2, the exit does not lead to the adjacent machinery or accommodation space;

the distance from each point of maintenance to the exit, or ladder to the open deck, is not longer than 5 m, and a fire extinguisher is located at the point of maintenance.

4.5.5 Machinery spaces which are not covered by 4.5.3 as well as incinerator spaces may have one means of escape.

Workshops, fuel oil units spaces, boilers for fuel oil equipment testing, etc., enclosed within machinery spaces, are allowed to have exits leading into these spaces.

The main machinery control room and the main switchboard space enclosed within the engine room are to have their own independent means of escape according to 4.5.7, in addition to entrances to the engine room. In case of a smaller engine room (not more than 35 m^2) or where exits from these spaces are located close (not farther than 5 m) to the engine room exit, an independent means of escape from the main machinery control room may be omitted on agreement with the Register.

4.5.6 If two adjacent machinery spaces communicate through doors and each of them has only one means of escape through the casing, these means of escape are to be located on the opposite sides.

4.5.7 Exits from cargo pump rooms are to lead directly to the open deck. Exits to other machinery spaces are not allowed.

4.5.8 Exits from machinery spaces are to lead to such places which provide ready access to the lifeboat embarkation deck.

4.5.9 On ships carrying dangerous goods, the engine rooms are to be accessible from the deck. The entrances are not to face the cargo area. Where the doors are not located in a recess whose depth is at least equal to the door width, the hinges are to face the cargo area.

4.5.10 All the doors as well as the covers of companionways and skylights which may serve as exits from machinery spaces are to be capable of being opened and closed both from inside and outside. Covers of companionways and skylights are to bear clear inscription prohibiting stowage of any load thereon.

Covers of skylights which are not intended to be used for exits, as a minimum, are to be fitted with means for closing them from outside.

Doors and hatch covers of cargo pump rooms on oil tankers are to be capable of being opened and closed both from inside and from outside; their design is to preclude the possibility of sparking.

4.6 INSULATION OF HEATED SURFACES

4.6.1 To ensure fire protection, surfaces of machinery, equipment and pipelines which may be heated to a temperature over 220 °C are to be insulated. At places where personnel may likely come into contact (under normal service conditions) with an insulated item, the temperature of the insulation surface is not to exceed 60 °C, and at working places – 45 °C. Measures are to be taken to prevent damage to insulation from vibration and mechanical shocks.

4.6.2 Insulating materials and surface of insulation are to comply with the requirements of 2.2, Part V "Fire Protection".

4.6.3 On ships carrying dangerous goods, the surface temperature of the outer parts of engines used during loading and unloading operations, as well as that of their air inlets and exhaust ducts is not to exceed the allowable temperature according to the temperature class of the substance carried.

5 SHAFTING

5.1 GENERAL

5.1.1 The minimum shaft diameters without allowance for subsequent turning on lathe during service life are to be determined by the formulae given in the present Section. It is assumed that additional stresses from torsional vibrations will not exceed permissible values stipulated in Section 8.

5.1.2 On ships with no obstruction for the propeller shaft to slip out of the sterntube, devices are to be provided which, in the event of the propeller shaft breaking, will prevent its slipping out of the stern gland; or measures are to be taken to preclude flooding of the engine room, in case of the propeller shaft loss.

5.2 CONSTRUCTION AND DIAMETERS OF SHAFTS

5.2.1 The design diameter of the intermediate shaft d_{int}, in mm, is not to be less than that determined by the following formula:

$$d_{int} = 0{,}95F\sqrt[3]{P/n} \tag{5.2.1}$$

where F = factor taken depending on the type of machinery installation as follows:
95 for installations with main machinery of rotary type or with main internal combustion engines fitted with hydraulic or electromagnetic couplings;
100 for other machinery installations with internal combustion engines;
P = rated power of intermediate shaft, in kW;
n = rated speed of intermediate shaft, in rpm.

5.2.2 The diameter of the thrust shaft in outboard sliding bearing on a length equal to thrust shaft diameter on either side of the thrust collar and, where roller thrust bearings are used, on a length within the housing of thrust bearing, is not to be less than 1,05 times the intermediate shaft diameter determined by the Formulae (5.2.1), (5.2.4). Beyond the said lengths the diameter of the thrust shaft may be tapered to that of the intermediate shaft.

5.2.3 The design diameter of the propeller shaft d_p, in mm, is not to be less than that determined by the following formula:

$$d_p = 95k\sqrt[3]{P/n} \tag{5.2.3}$$

where k = factor assumed from the shaft design features as follows:
for the portion of propeller shaft between the propeller shaft cone base or the aft face of the propeller shaft flange and the forward edge of the aftermost shaft bearing, subject to a minimum of 2,5 d_p;
1,22, where the propeller is keyless fitted onto the propeller shaft taper or is attached to an integral propeller shaft flange;
1,26, where the propeller is keyed onto the propeller shaft taper;
for the part of propeller shaft between the forward edge of the aftermost shaft bearing and the forward edge of the forward sterntube seal k = 1,15, for all types of design.

Other terms are defined in 5.2.1.

On the part of propeller shaft forward of the forward edge of the forward sterntube seal the diameter of the propeller shaft may be tapered to the actual diameter of the intermediate shaft.

Where surface hardening is used, diameters of propeller shafts may be reduced on agreement with the Register.

5.2.4 The diameter of the shaft made of steel with tensile strength more than 400 MPa may be determined by the following formula:

$$d_{red} = d\sqrt[3]{560/(R_{m_{sh}} + 160)} \tag{5.2.4}$$

where d_{red} = reduced diameter of the shaft, in mm;
d = design diameter of the shaft, in mm;
$R_{m_{sh}}$ = tensile strength of the shaft material.

In all cases, the tensile strength value in the above formula is not to exceed 800 MPa for intermediate and thrust shafts and 600 MPa for the propeller shaft.

5.2.5 Diameters of shafts on ships provided with ice strenthening are to exceed the design value by 5 per cent. Diameters of propeller shafts, in mm, are, moreover, to meet the following condition in way of aft bearings:

$$d \geqslant a \sqrt[3]{bs^2 R_{m_{bl}} / R_{eH}} \quad (5.2.5)$$

where a = factor equal to:
10,8, with propeller boss diameter equal to, or less than $0{,}25D$;
11,5, with propeller boss diameter greater than $0{,}25D$ (D = propeller shaft diameter);
b = actual width of expanded cylindrical section of the blade at the radius of $0{,}25R$ for solid propellers and $0{,}35R$ for CPP, in m;
s = maximum actual thickness of expanded cylindrical section of the blade at the radii given for b, in mm;
$R_{m_{bl}}$ = tensile strength of the blade material, in MPa;
R_{eH} = yield stress of the propeller shaft material, in MPa.

5.2.6 If the shaft has a central hole, its bore is not to exceed 0,4 of the design diameter of the shaft.

If necessary, the diameter of central hole may be increased to the value determined by the following formula:

$$d_c \leqslant (d_a^4 - 0{,}97d^3 d_a)^{1/4} \quad (5.2.6)$$

where d_c = diameter of central hole;
d_a = actual shaft diameter;
d = design diameter of the shaft without the central hole.

5.2.7 Where the shaft has a radial or transverse hole, the shaft diameter is to be increased over a length of at least seven diameters of a hole. The hole is to be located at mid-length of the bossed portion of the shaft, and its diameter is not to exceed 0,3 of the shaft design diameter. In all cases, irrespective of the hole diameter, of the shaft diameter is to be increased by not less than 0,1 times the design diameter. Edges of the hole are to be rounded to a radius not less than 0,35 times its diameter and the inside surface is to be smooth.

5.2.8 The diameter of the shaft having a longitudinal slot is to be increased by at least 0,2 of the design diameter of the shaft; the length of the slot is to be not more than 1,4 and the width of the slot not more than 0,2 of the shaft design diameter.

The bossed part of the shaft is to be of such length as to extend beyond the slot, either side, for not less than 0,25 of the shaft design diameter. The transition from one diameter to another is to be smooth. Ends of the slot are to be rounded to a radius of half the width of the slot and the edges – to a radius of at least 0,35 times the width; the surface of the slot is to be smooth.

5.2.9 The diameter of the shaft having a keyway is to be increased by at least 0,1of its design diameter. At a length of not less than 0,2 of the design diameter from the ends of the keyway, no increase of the shaft diameter is required.

If the keyway is made on the outboard end of the propeller shaft, the diameter may not be increased.

5.2.10 For intermediate shafts, thrust shafts and inboard end of propeller shafts the coupling flange is to have a minimum thickness of 0,2 times the required diameter of the intermediate shaft, or the thickness equal to the coupling bolt diameter determined by the Formula (5.3.2) for the shaft material, whichever is greater.

The thickness of the coupling flange of the outboard end of the propeller shaft under the bolts heads is to be not less than 0,25 times the required diameter of the shaft at the flange.

5.2.11 The fillet radius at the base of the aft flange of the propeller shaft is to be not less than 0,125 and for other flanges of shafts – not less than 0,08 of the required diameter at the flange. The fillet may be formed by multiradii in such a way that the stress concentration factor be not greater than that for a constant fillet radius.

Fillets are to be smooth and not to be recessed in way of nuts and bolts heads.

5.2.12 Fillet radii in the transverse section of the bottom of the keyway are to be not less than 0,0125 of the shaft diameter, but at least 1 mm.

5.2.13 Where keys are used to fit the propeller on the propeller shaft cone, the latter is to have a taper not exceeding 1:12, in case of keyless fitting – according to 5.4.1.

5.2.14 On the cone base side, keyways in the shaft cones are to be ski-shaped, while in propeller shaft cones are to be spoon-shaped in addition.

Where the outboard end of a propeller shaft having the diameter in excess of 100 mm is concerned, the distance between the cone base and the ski-shaped keyway end is to be at least 0,2 of the shaft diameter required, with the ratio of the keyway depth to the shaft diameter less than 0,1 and 0,5 at least of the shaft diameter required, with the ratio of the keyway depth to the shaft diameter exceeding 0,1.

In coupling shaft cones, the ski-shaped keyway end is not to extend beyond the cone base.

Where the key is secured by screws in the keyway, the first screw is to be positioned at least 1/3 of she shaft cone length from the shaft cone base. The bore length is not to exceed the propeller diameter. The bore edges are to be rounded off. Where the shaft has blind axial bores, bore edges and the end are to be also rounded off. The fillet radius is to be not less than that specified in 5.2.12.

5.2.15 The thickness of a bronze liner, in mm, is not to be less than that determined by the following formula:

$$s = 0{,}03d_p' + 7{,}5 \quad (5.2.17)$$

where d_p' = diameter of the propeller shaft under the liner, in mm.

The thickness of the liner between bearings may be reduced to $0{,}75s$.

5.2.16 Continuous liners are recommended to be used.

Liners consisting of two or more lengths are to be joined by welding or by other methods approved by the Register. Butt weld joints of the liner are to be arranged outside the region of bearings. In case of non-continuous liners, the part of the shaft between the liners is to be protected against the action of sea water by a method approved by the Register.

5.2.17 To prevent water from reaching the propeller shaft cone, the appropriate sealing is to be provided.

Structural provision is to be made for hydraulic testing of the sealing.

5.2.18 The liners are to be shrunk on the shaft in such a way as to provide tight interference between mating surfaces. The use of pins or other parts for securing the liners to the shaft is not allowed.

5.3 SHAFT COUPLINGS

5.3.1 The bolts used at the coupling flanges of shafts are to be all fitted bolts of cylindrical section.

The possibility of using coupling flanges without fitted bolts is subject to special consideration by the Register in each case.

5.3.2 The coupling bolt diameter d_b, in mm, is not to be less than that determined by the following formula:

$$d_b = 0{,}65\sqrt{d_{int}^3(R_{m_{sh}} + 160)/iDR_{m_b}} \qquad (5.3.2)$$

where d_{int} = diameter of intermediate shaft determined by the Formula (5.2.1) taking into account the ice strengthening under 5.2.5, in mm.
If the shaft diameter is increased to account for torsion vibration, d_{int} is to be taken as the increased diameter of the intermediate shaft;
$R_{m_{sh}}$ = tensile strength of the shaft material, in MPa;
R_{m_b} = tensile strength of the fitted coupling bolt material, in MPa, taken:
$R_{m_{sh}} \leqslant R_{m_b} \leqslant 1{,}7R_{m_{sh}}$, but not higher than 1000 MPa;
i = number of fitted coupling bolts;
D = pitch circle diameter of coupling bolts, in mm.

The diameter of bolts by which the propeller is secured to the propeller shaft flange is subject to special consideration by the Register in each case.

5.4 KEYLESS FITTING OF PROPELLER AND SHAFT COUPLINGS

5.4.1 In case of keyless fitted propellers and shaft couplings, the taper of the shaft cone is not to exceed 1:15. Provided the taper does not exceed 1:50, the shafts may be assembled without the use of an end nut or other means of securing the coupling.

Stoppers of the end nuts are to be secured to the shaft.

5.4.2 A keyless assembly is to generally be constructed without a sleeve between the propeller boss and the shaft.

Constructions with intermediate sleeves are subject to special consideration by the Register in each case.

5.4.3 When fitting the keyless shrunk assembly, the axial pull-up of the boss in relation to the shaft or intermediate sleeve, as soon as the contact between mating surfaces is obtained after eliminating the clearance, is to be determined by the following formula:

$$\Delta h = \Big[\frac{80B}{hz}\sqrt{(1910PL^3/nD_w)^2 + T^2} + $$
$$+ D_w(\alpha_y - \alpha_w)(t_e - t_m)/z\Big]k \qquad (5.4.3)$$

where Δh = axial pull-up of the boss in the course of fitting, in cm;
B = material and shape factor of the assembly, in MPa^{-1}, determined by the following formula:

$$B = \frac{1}{E_y}[(y^2+1)/(y^2-1)+\nu_y] + \frac{1}{E_w}[(1+w^2)/(1-w^2)-\nu_w].$$

For assemblies with a steel shaft having no axial bore, the factor B may be obtained from Table 5.4.3 using linear interpolation;
E_y, E_w = moduli of elasticity of boss and shaft material, in MPa;
ν_y = Poisson's ratio for the boss material;
ν_w = Poisson's ratio for the shaft material; for steel V_w =0,3;
y = mean factor of the outside boss diameter;
w = mean factor of the shaft bore;
D_w = mean outside shaft diameter in way of contact with the boss or intermediate sleeve (refer to Fig. 5.4.3):

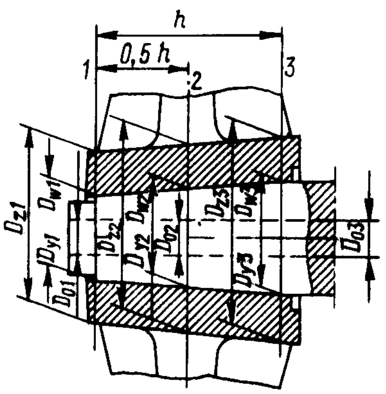


Fig. 5.4.3

without intermediate sleeve

$$D_{w1} = D_{y1}; \quad D_{w2} = D_{y2}; \quad D_{w3} = D_{y3};$$

$$D_w = D_y;$$

with intermediate sleeve

$$D_{w1} \neq D_{y1}; \quad D_{w2} \neq D_{y2}; \quad D_{w3} \neq D_{y3};$$

$$D_w \neq D_y;$$

$$y = (D_{z1} + D_{z2} + D_{z3})/(D_{y1} + D_{y2} + D_{y3}) \text{ for the boss;}$$

$$w = (D_{01} + D_{02} + D_{03})/(D_{w1} + D_{w2} + D_{w3}) \text{ for the shaft;}$$

$$D_w = (D_{w1} + D_{w2} + D_{w3})/3;$$

$$D_y = (D_{y1} + D_{y2} + D_{y3})/3,$$

where D_y = mean internal boss diameter in way of contact with the shaft or intermediate sleeve, in cm;
h = active length of the shaft cone or sleeve at the contact with the boss, in cm;
z = taper of the boss;

Table 5.4.3

Factor $B \times 10^5$ MPa^{-1}, for fittings with steel shafts $w = 0$, $E_w = 2{,}059 \times 10^5$ MPa, $\nu_w = 0{,}3$

Factor y	Copper alloy boss, ν_y = 0,34 with E_y, in MPa							Steel boss, $\nu_y = 0{,}3$ with $E_y = 2{,}059 \times 10^5$, in MPa
	$0{,}98 \times 10^5$	$1{,}078 \times 10^5$	$1{,}176 \times 10^5$	$1{,}274 \times 10^5$	$1{,}373 \times 10^5$	$1{,}471 \times 10^5$	$1{,}569 \times 10^5$	
1,2	6,34	5,79	5,34	4,96	4,63	4,34	4,09	3,18
1,3	4,66	4,26	3,95	3,66	3,43	3,22	3,04	2,38
1,4	3,83	3,52	3,25	3,03	2,83	2,67	2,52	1,98
1,5	3,33	3,07	2,83	2,64	2,48	2,34	2,21	1,74
1,6	3,01	2,77	2,57	2,40	2,24	2,12	2,01	1,59
1,7	2,78	2,48	2,38	2,22	2,09	1,97	1,87	1,49
1,8	2,62	2,38	2,23	2,09	1,97	1,86	1,76	1,41
1,9	2,49	2,29	2,13	1,99	1,88	1,77	1,68	1,35
2,0	2,39	2,20	2,05	1,92	1,80	1,70	1,62	1,29
2,1	2,30	2,13	1,98	1,86	1,74	1,65	1,57	1,25
2,2	2,23	2,06	1,92	1,79	1,69	1,60	1,53	1,22
2,3	2,18	2,01	1,88	1,75	1,65	1,57	1,49	1,19
2,4	2,13	1,97	1,84	1,72	1,62	1,54	1,46	1,17

P = power transmitted by the assembly, in kW;
n = rotation speed, in rpm;
L = factor equal to 1,05 accounting for ice strengthening; in other cases $L = 1$;
T = propeller thrust at ahead speed, in kN;
α_y, α_w = thermal coefficients of linear expansion of the boss and shaft material, respectively, 1/°C;
t_e, t_m = temperatures of the assembly in service conditions and in course of fitting, respectively, in °C;
k = 1 for assemblies without intermediate sleeve;
k = 1,1 for assemblies with intermediate sleeve.

For ships with ice strengthening, the value Δh is to be chosen as the greater of the results obtained from calculations for extreme service temperatures, i.e.: for $t_e = 35$ °C at $L = 1$; $t_e = 0$ °C at $L > 1$. For other ships the calculation is to be made solely for the maximum service temperature $t_e = 35$ °C at $L = 1$.

5.4.4 When assembling steel couplings and shafts with cylindrical mating surfaces, the interference fit is to be determined by the following formula:

$$\Delta D = \frac{80B}{h}\sqrt{(1910PL^3/nD_w)^2 + T^2} \qquad (5.4.4)$$

where Δh = interference fit for D_w, in cm.
Other terms are defined in 5.4.3.

5.4.5 For propeller bosses and half-couplings in keyless assemblies with shafts, the following condition is to be met:

$$\frac{A}{B}[C/D_y + (\alpha_y - a_w)t_m] \leqslant 0{,}75R_{eH} \qquad (5.4.5)$$

where A = shape factor of the boss,

$$A = \frac{1}{y^2 - 1}\sqrt{1 + 3y^4}\ .$$

The factor A may be obtained from Table 5.4.5 by linear interpolation;
C = $\Delta h_r z$ for assemblies with conical mating surfaces;
C = ΔD_r for assemblies with cylindrical mating surfaces;
Δh_r = actual pull-up of the boss in the course of fitting at a temperature t_m, in cm, $\Delta h_r \geqslant \Delta h$;
ΔD_r = actual interference fit of the assembly with cylindrical mating surfaces, in cm, $\Delta D_r \geqslant \Delta D$;
R_{eH} = yield stress of the boss material, in MPa.
Other terms are defined in 5.4.3.

Table 5.4.5

Factor *A*

y	A	y	A
1,2	6,11	1,9	2,42
1,3	4,48	2,0	2,33
1,4	3,69	2,1	2,26
1,5	3,22	2,2	2,20
1,6	2,92	2,3	2,15
1,7	2,70	2,4	2,11
1,8	2,54		

5.5 SHAFT BEARINGS

5.5.1 The length of the bearing nearest to the propeller is to be taken according to Table 5.5.1.

Table 5.5.1

Relative length of the bearing

Bearing material	l/d[1]
White metal	2[2]
Lignum vitae	4
Rubber or other synthetic water-lubricated materials approved by the Register	4[3]

[1] l = bearing length; d = design shaft diameter in way of bearing.
[2] The bearing length may be reduced if the pressure on the bearing does not exceed 0,8 MPa. In this case, the mass of the shaft and the propeller is to be taken as the load, considering that it acts only on the aft bearing. In all cases, the length of the bearing is to be not less than 1,5 of the actual shaft diameter in way of the bearing.
[3] The bearing length may be reduced to two design diameters in way of the aft bearing if the results of the operational check are satisfactory.

5.5.2 The water cooling of sterntube bearings is to be of forced type (refer to 14.1, Part VII "Systems and Piping").

The water supply system is to be provided with a flow indicator and with alarms for minimum flow of water.

Where an open system of seawater lubrication is applied for sterntube bearings of ships operating in shallow waters, or of special purpose ships, such as wet dredgers, suction dredgers, etc., it is recommended to fit an efficient seawater cleaning device (filter, cyclone filter, etc.) in the circulation system of the sterntube bearing, or to fit sternbush bearings with mud collectors to be washed subsequently.

The shut-off valve controlling the supply of water to the sterntube bearings is to be fitted on the sterntube or on the afterpeak bulkhead.

5.5.3 Oil-lubricated sternbush bearings are to be provided with forced oil cooling arrangements unless the afterpeak tank is permanently filled with water.

Indication of temperature of oil or bearing bush is to be provided.

5.5.4 If the sterntube bearings are oil-lubricated, lubricating oil tanks are to be fitted with oil level indicators and low level alarms.

5.5.5 The distance between the centres of adjacent bearings of the shafting, where there are no concentrated masses in the span, is to meet the following condition:

$$5{,}5\sqrt{d} \leqslant l \leqslant \lambda\sqrt{d} \qquad (5.5.5)$$

where l = distance between bearings, in m;
d = shaft diameter between bearings, in m;
λ = factor taken equal to:
14 for $n \leqslant 500$, in rpm;
$300/\sqrt{n}$ for $n > 500$, in rpm (n = rated speed of the shaft, in rpm).

5.6 BRAKING DEVICES

5.6.1 The shafting is to comprise the appropriate braking device. A brake, a stopping or a shaft turning gear preventing rotation of the shaft in case the main engine goes out of action may be used as such a device.

5.7 HYDRAULIC TESTS

5.7.1 Propeller shaft liners and cast sterntubes are to be hydraulically tested to a pressure of 0,2 MPa upon completion of machining. Hydraulic tests of welded and forged-and-welded sterntubes may be omitted provided non-destructive tests are carried out on 100 per cent of welds.

5.7.2 After assembling the sterntube sealing glands are to be tested for tightness by a pressure head up to the working level of liquid in gravity tanks. In general, the test is to be carried out while the propeller is turning.

6 PROPELLERS

6.1 GENERAL

6.1.1 The requirements of the present Section apply to metal fixed-pitch propellers, both solid and detachable-blade propellers, as well as to controllable-pitch propellers.

6.1.2 The design and size of propellers of the main active means of the ship's steering are to meet the requirements of the present Section.

The design of vertical-axis and jet propellers is subject to special consideration by the Register in each case.

The scope of requirements for the design and size of propellers of the auxiliary AMSS may be reduced on agreement with the Register.

6.2 BLADE THICKNESS

6.2.1 Propeller blade thickness is checked in the design root section and in the blade section at the radius $r = 0{,}6R$, where R is the propeller radius. The design root section is adopted as follows:

for solid propellers – at the radius $0{,}2R$ where the propeller boss radius is smaller than $0{,}2R$, and at the radius $0{,}25R$ where the propeller boss radius is greater than or equal to $0{,}2R$;

for detachable-blade propellers – at the radius $0{,}3R$, the values of the factors A and C being adopted for $r = 0{,}25R$;

for CPP – at the radius $0{,}35R$.

N o t e . In the design section, the blade thickness is determined with the fillets being neglected.

In solid propellers, detachable-blade propellers and CPP, the maximum thickness s, in mm, of an expanded cylindrical section is not to be less than that determined by the following formula:

$$s = 9{,}8[A\sqrt{0{,}14kP/zb\sigma n} + c\,\frac{m}{\sigma}(Dn/300)^2] \qquad (6.2.1)$$

where A = coefficient determined by the nomograph in Fig. 6.2.1 depending on the assumed radius r/R of the design section and pitch ratio H/D at this radius (for a CP-propeller pitch ratio of the basic design operating condition is adopted);

k = coefficient, obtained from Table 6.2.1-1;

P = shaft power at the rated output of the main machinery, in kW;

z = number of blades;

b = width of the expanded cylindrical section of the blade at the design radius, in m;

σ = 0,6 $R_{m_{bl}}$ + 175 MPa, but not more than 570 MPa for steels and not more than 610 MPa for copper alloys; 290 MPa for cast iron;

$R_{m_{bl}}$ = tensile strength of the blade material, in MPa;

n = propeller speed at the rated output, in rpm;

c = coefficient of centrifugal stresses determined from Table 6.2.1-2;

m = blade rake, in mm;

D = propeller diameter, in m.

Holes for the items securing propellers detachable blades of and CP-propellers blades are not to reduce the design root section.

6.2.2 The blade tip thickness at the radius $D/2$ is not to be less than:

0,0035D – for machinery installations of ships without ice strengthening;

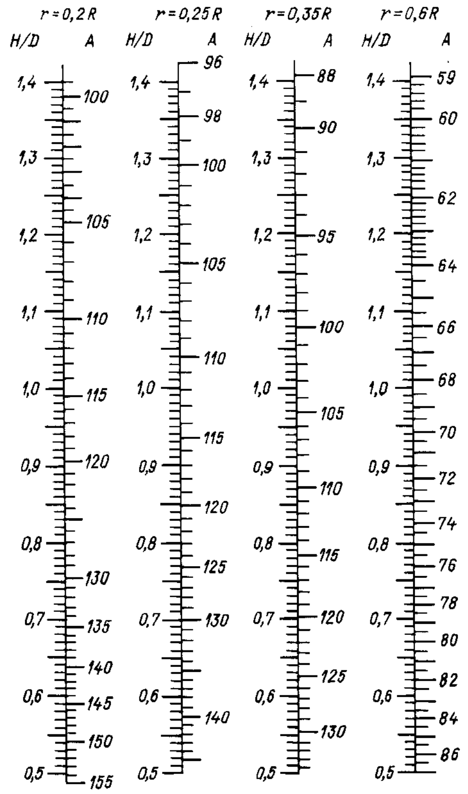


Fig. 6.2.1

Table 6.2.1-1

Coefficient *k*

Material	Machinery installations of ships	
	Without ice strengthening	With ice strengthening
Special brass or bronze	7,8	8,5
Cast steel	8,6	9,4
Cast iron	8,8	-

Notes: 1. If reciprocating engines with less than four cylinders are installed on the ship, k is to be increased by 7 per cent.

2. For reciprocating units fitted with hydraulic or electromagnetic couplings, k may be reduced by 5 per cent.

3. For twin-screw ships without ice strengthening, k may be reduced by 7 per cent.

Table 6.2.1-2

Coefficient *c*

r/R	c
0,20	0,50
0,25	0,45
0,35	0,30
0,60	0

$0,005D$ – for machinery installations of ships with ice strengthening.

6.2.3 The blade thickness calculated according to 6.2.1 and 6.2.2 in sound cases (e.g. for blades of particular shape) may be reduced, provided a detailed strength calculation is submitted to the Register for consideration.

6.2.4 The thickness of a high-skewed ($\theta > 25°$) blade with an asymmetrical outline of the normal projection is to be checked in compliance with the requirements of 6.2.1. Besides, the blade thickness at the radius $0,6R$ at a distance of 0,8 of the width of section b from the leading edge is to be not less than that determined by the following formula:

$$s_k = 0,4s(1 + 0,064\sqrt{\theta - 25}) \qquad (6.2.4)$$

where s = is determined by the Formula (6.2.1) at the radius $0,6R$;
θ = angle, in degrees, equal to angle θ_1 or θ_2, whichever is greater (refer to Fig. 6.2.4).

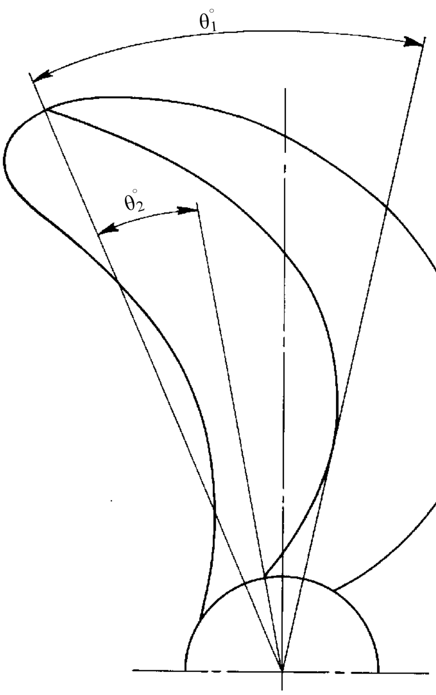


Fig. 6.2.4:
θ_1° = angle between the radius drawn through the blade tip centre and the radius tangent to the mid-chord;
θ_2° = angle between radii drawn through the blade tip and root section centre of the blade

If smoothness of the blade section profile at the radius $0,6R$ under condition of mandatory compliance with the requirements for the minimum thickness close to the rear edge (on $0,8b$) is not provided, thickness s at the radius $0,6R$ is to be increased.

6.2.5 The most loaded parts of the pitch control mechanism are to remain undamaged if the blade is broken due to flatwise impact.

6.3 PROPELLER BOSS AND BLADE FASTENING PARTS

6.3.1 Fillet radii of the transition from the root of a blade to the boss are to be not less than $0,04D$ on the suction side of the blade and not less than $0,03D$ on the pressure side.

If the blade has no rake, the fillet radius on both sides is to be at least $0,03D$.

Smooth transition from the blade to the boss using a variable radius may be allowed.

6.3.2 The propeller boss is to be provided with holes through which empty spaces between the boss and the shaft cone are filled with non-corrosive mass; the latter is also to fill the space inside the propeller cap.

6.3.3 The diameter of the bolts (studs) by which the blades are secured to the propeller boss or the internal diameter of the thread of such bolts (studs), whichever is less, is not to be less than that determined by the following formula:

$$D_b = ks\sqrt{bR_{m_{bl}}/dR_{m_b}} \qquad (6.3.3)$$

where k = 0,33 in case of three studs in blade flange, at thrust surface;
0,30 in case of four studs in blade flange, at thrust surface;
0,28 in case of five studs in blade flange, at thrust surface;
s = maximum actual thickness of the blade at design root section (refer to 6.2.1), in mm;
b = width of expanded cylindrical section of the blade at the design root section, in mm;
$R_{m_{bl}}$ = tensile strength of blade material, in MPa;
R_{m_b} = tensile strength of bolt (stud) material, in MPa;
d = diameter of stud pitch circle; with other arrangement of studs, $d = 0,85l$ (l = the distance between the most distant studs), in m.

6.4 PROPELLER BALANCING

6.4.1 The completely finished propeller is to be statically balanced.

The extent of balancing is to be checked by a test load, which, when suspended from the tip of every blade in horizontal position, is to cause the propeller rotation. The mass of the test load is not to be more than that determined by the following formula:

$$m \leqslant km_p/R \qquad (6.4.1)$$

where m = mass of the test load, in kg;
m_p = propeller mass, in t;
R = propeller radius, in m;
k = 0,75 for $n \leqslant 200$;
0,5 for $200 < n \leqslant 500$;
0,25 for $n > 500$;
n = rated rotation speed of the propeller, in rpm.

6.5 CONTROLLABLE PITCH PROPELLERS

6.5.1 The hydraulic power system of the controllable pitch propeller is to be fitted with two pumps of equal capacity, main and reserve, one of which may be driven from the main machinery. The power driven pump is to provide blade adjustment under any operating mode of the main machinery.

Where more than two pumps are fitted, their capacity is to be determined on assumption that, if any of the pumps fails, the aggregate capacity of the rest are to be sufficient to ensure the blade adjustment time not longer than that stipulated by 6.5.5.

On ships with two CP-propellers one independent standby pump may be provided for both CP-propellers.

On ships with the main machinery total rated output less than 220 kW a manual pump or a manual drive for blades turning may be used as a reserve pump.

6.5.2 The pitch control unit is to be designed so as to enable adjusting the blade into ahead speed position, if the hydraulic power system fails.

6.5.3 On ships with a CP-propeller where the main engine may be overloaded due to particular service conditions, it is recommended to use automatic protection against overloading of the main engine.

6.5.4 The hydraulic power system is to be constructed according to the requirements of Section 7, Part VIII "Machinery", and the pipelines of this system are to be tested according to Section 20, Part VII "Systems and Piping".

6.5.5 The time required for the blades to be adjusted from full ahead to full astern speed position with the main machinery inoperative is not to exceed 20 s for CP-propellers up to and including 2 m in diameter, and 30 s for CP-propellers with diameters over 2 m.

6.5.6 In the gravity lubrication systems of CP-propellers, gravity tanks are to be installed above the deepest load waterline and be provided with level indicators and low level alarms.

6.6 HYDRAULIC TESTS

6.6.1 The sealings fitted to the cone and flange casing of the propeller shaft after the propeller installation are to be tested to a pressure of at least 0,2 MPa. If the above sealings are under pressure of oil from the sterntube or the propeller boss, they are to be tested in conjunction with sterntube seals or propeller boss.

6.6.2 After being assembled with the blades a CP-propeller boss is to be tested by internal pressure equal to a head up to the working level of oil in the gravity tank, or by a pressure created by the lubricating pump of the boss.

In general, the test is to be carried out during blade adjustment.

7 ACTIVE MEANS OF THE SHIP'S STEERING

7.1 GENERAL

7.1.1 The requirements of the present Section apply to AMSS as defined in 1.2.

The requirements for steering nozzles and steering systems of active rudders are given in Section 2, Part III "Equipment, Arrangements and Outfit".

7.1.2 Construction requirements to the active means of the ship’s steering are given in Section 7, Part VII "Machinery Installations" of Rules for the Classification and Construction of Sea-Going Ships.

8 TORSIONAL VIBRATION

8.1 GENERAL

8.1.1 The requirements of the present Section applies to machinery installations with the main engines having a power of not less than 75 kW when ICE are used and of not less than 110 kW when using electric drive, and also to diesel generators and ICE-driven auxiliary machinery having a power of not less than 110 kW.

8.1.2 Torsional vibration calculations are to be made both for the basic operational variant and for other variants and conditions possible in the operation of the installation:

.1 maximum power take-off and idling speed (with the propeller blades at zero position) for installations comprising CP-propellers or Voith-Schneider propellers;

.2 individual and parallel operation of main engines with a common reduction gear;

.3 reverse-reduction gear engagement;

.4 connection of additional power consumers if their moments of inertia are commensurate with the inertia moments of the working cylinder;

.5 running with one cylinder out-of-operation, for installations containing flexible couplings and reduction gear; "out-of-operation" is considered to be a cylinder the disconnection of which accounts to the greatest degree for increase of stresses and alternating torques.

No calculations are to be submitted if it is documented that the installation is fully similar to that approved earlier or that its mass inertia moments or torsional stiffness between masses do not differ from the basic ones by 10 per cent and 5 per cent, respectively.

8.1.3 Torsional vibration calculations are to include:

.1 details of all the installation components: specifications of the engine, propeller, damper, flexible coupling, reduction gear, generator, etc.;

rotation speeds corresponding to the principal long-term operating conditions specified for operation under partial loads (half speed, slow speed, dead slow speed, towing operation, zero-speed operation for installations comprising CP-propellers, main diesel generator conditions, etc.);

layouts of all installation operating conditions possible;

initial data for the design torsional diagram of the installation;

.2 natural frequency tables for all basic modes of vibration having a resonance up to 12th order inclusive within the speed range $(0 – 1,2)n_r$ with relative vibration amplitudes of masses and moments, and with scales of stresses (torques) for all sections of the system;

.3 for each order of all vibration modes under consideration:

resonance vibration amplitudes of the first mass of the system;

resonance stresses (torques) in all the system components (shafts, reduction gear, couplings, generators, compression or compression-key joints, etc.) and temperatures of the rubber components of flexible couplings as compared to the relevant permissible values;

.4 total stresses (torques), where it is necessary to consider the simultaneous effect of disturbing moments of several orders, as compared to the relevant permissible values;

.5 stress (torque) curves for the principal sections of the system with indication of permissible values for continuous running and rapid passage and of restricted rotation speed ranges where these are assigned;

.6 conclusions based on the results of calculation.

8.2 PERMISSIBLE STRESSES FOR CRANKSHAFTS

8.2.1 For the main engine crankshafts and crankshafts of engines driving generators and other essential auxiliary machinery within the speed range (0,9 – 1,05) n_r, the total stresses due to torsional vibration under continuous running conditions are not to exceed the values determined by the following formulae:

when calculating a crankshaft in accordance with the requirements Section 2, Part VIII "Machinery":

$$\tau_1 = \pm\tau_N\,; \qquad (8.2.1\text{-}1)$$

when calculating a crankshaft by another method:

$$\tau_1 = \pm 0{,}76[(R_m + 160)/18]C_d\,; \qquad (8.2.1\text{-}2)$$

within rotation speed ranges lower than $0{,}9nr$:

$$\tau_1 = \pm\tau_N[3 - 2(n/n_r)^2]/1{,}38; \qquad (8.2.1\text{-}3)$$

or

$$\tau_1 = \pm 0{,}55[(R_m + 160)/18]C_d[3 - 2(n/n_r)^2] \qquad (8.2.1\text{-}4)$$

where t_1 = permissible stresses, in MPa;

t_N = maximum alternating torsional stress determined during crankshaft calculation by the Formula (2.4.5.1), Part VIII "Machinery" for the maximum value of W_p;

R_m = tensile strength of the shaft material, in MPa. When using materials with the tensile strength above 800 MPa, $R_m = 800$ MPa is to be adopted for calculation purposes;

n = rotation speed under consideration, in rpm. For tugs, fishing trawlers and other ships the main engines of which run continuously under conditions of the maximum torque at speeds below the rated speed throughout the working speed range, $n = n_r$ is to be adopted and the Formulae (8.2.1-1) and (8.2.1-2) are to be used. For the main diesel generators of ships with electric propulsion plants, all the specified values of n_r are to, by turn, be

adopted as n, and in each of the ranges $(0,9 - 1,05)n_r$, the Formulae (8.2.1-3) and (8.2.1-4) are to be used for partial loads;
n_r = rated speed, in rpm;
$C_d = 0,35 + 0,93d^{-0,2}$ – scale factor;
d = shaft diameter, in mm.

8.2.2 The total stresses due to torsional vibration within rotation speed ranges prohibited for continuous operation, but which may only be rapidly passed through are not to exceed the values determined by the following formulae:

for the main engines crankshafts:

$$\tau_2 = 2\tau_1 \; ; \qquad (8.2.2\text{-}1)$$

for crankshafts of engines driving generators or other essential auxiliary machinery:

$$\tau_2 = 5\tau_1 \qquad (8.2.2\text{-}2)$$

where τ_2 = permissible stresses for speed ranges to be rapidly passed through, in MPa;
τ_1 = permissible stresses determined by one of the Formulae (8.2.1-1) to (8.2.1-4).

8.3 PERMISSIBLE STRESSES FOR INTERMEDIATE, THRUST, PROPELLER SHAFTS AND GENERATOR SHAFTS

8.3.1 Under continuous running conditions, the total stresses due to torsional vibration are not to exceed the values determined by the following formulae:

within the rotation speed range $(0,9 - 1,05)\, n_r$:

$$\tau_1 = \pm 1{,}38[(R_m + 160)/18]C_k C_d \; ; \qquad (8.3.1\text{-}1)$$

within the rotation speed range below $0,9n_r$:

$$\tau_1 = \pm[(R_m + 160)/18]C_k C_d[3 - 2(n/n_r)^2] \qquad (8.3.1\text{-}2)$$

where R_m = tensile strength of the shaft material, in MPa. Where intermediate and thrust shaft materials having tensile strength above 800 MPa, or propeller shaft materials having tensile strength above 600MPa are used, R_m = 800 MPa and R_m = 600 MPa are to be adopted for calculation purposes, respectively;
C_k = factor obtained from Table 8.3.1;
for C_d = refer to 8.2.1.

8.3.2 The total stresses due to torsional vibration within rotation speed ranges prohibited for continuous running, but which only may be rapidly passed through are not to exceed:

for intermediate, thrust and propeller shafts and shafts of generators driven by the main engine:

$$\tau_2 = 1{,}7\tau_1/C_k^{0,5} \; ; \qquad (8.3.2)$$

for shafts of generators driven by auxiliary engines, the values determined by the Formula (8.2.2-2).

Table 8.3.1

Factor C_k

Structural shaft type		C_k
Intermediate shaft, thrust shaft in outboard thrust bearing outside the area of roller bearing or the collar area, generator shaft	with integral coupling flanges or shrink fit couplings	1,0
	with a radial or transverse hole (refer to 5.2.7)	0,70
	with a keyway (refer to 5.2.9)	0,60
	with a longitudinal slot having the length $L \leqslant 1,4d$, and the breadth $b \leqslant 0,2d$ where d is the design shaft diameter, in mm (refer to 5.2.8)	$0,70 - 0,25 \times L/d$
Thrust shaft in way of the collar or the roller thrust bearing (see 5.2.2)		0,85
Propeller shaft	forward sections ($k = 1,15$; refer to 5.2.3)	0,72
	portions in way of the after sterntube bearing and propeller (k = 1,22; k = 1,26; refer to 5.2.3)	0,55

8.4 PERMISSIBLE TORQUE IN REDUCTION GEAR

8.4.1 In case of continuous running and rapid passage, the alternating torques in any reduction gear step are not to exceed the permissible values established by the manufacturer for the operating conditions.

8.4.2 Where the values mentioned in 8.4.1 are not available, the alternating torque in any reduction gear step in case of continuous running is to satisfy the following conditions:

within the speed range $(0,9 — 1,05)n_r$:

$$M_{alt} \leqslant 0{,}3M_{nom}; \qquad (8.4.2\text{-}1)$$

within speed ranges lower than $0,9n_r$, the permissible value of alternating torque is subject to special consideration by the Register in each case, but, in any case:

$$M_{alt} \leqslant 1{,}3M_{nom} - M \qquad (8.4.2\text{-}2)$$

where M_{nom} = average torque in the step under consideration at nominal speed, in N·m;
M = average torque at the speed under consideration, in N·m.

In case of rapid passage, the alternating torque value is subject to special consideration by the Register in each case.

8.5 PERMISSIBLE TORQUE AND TEMPERATURE OF FLEXIBLE COUPLINGS

8.5.1 In case of continuous running and rapid passage, the alternating torque in a coupling, the relevant stresses or temperatures of the flexible component material due to torsional vibration are not to exceed the permissible values established by the manufacturer for service conditions.

8.5.2 Where the values mentioned in 8.5.1 are not available, the torque, stress and temperature values permissible for continuous running and rapid passage are to be determined by the procedures approved by the Register.

8.6 OTHER INSTALLATION COMPONENTS

8.6.1 Under continuous running conditions, the total torque (average torque plus alternating torque) is not to exceed the frictional torque in the keyless fitting of the propeller and shaft or shafting couplings.

8.6.2 Where, for generator rotors, the manufacturer's permissible values are not available, the alternating torque is not to exceed twice, in case of continuous running, or six times, in case of rapid passage, the nominal generator torque.

8.6.3 The schedule of torsional vibration damper maintenance, specified by the manufacturer is to be kept to, or the operational effectiveness of the dampers is to be confirmed by other means within the period specified.

8.7 TORSIONAL VIBRATION MEASUREMENT

8.7.1 Data obtained from torsional vibration calculations for installations with the main machinery are to be confirmed by measurements. The measurements are to cover all the variants and operation conditions of the installation for which calculations were made in accordance with 8.1.2.

In sound cases, the Register may require torsional vibrations to be measured in auxiliary diesel generators and essential ICE-driven auxiliary machinery.

8.7.2 The results of measurements obtained on the first ship (unit) of a series apply to all ships (units) of that series provided their engine – shafting – propeller (driven machinery) systems are identical.

8.7.3 The free resonance vibration frequencies obtained as a result of measurements are not to differ from the design values by more than 5 per cent. Otherwise, the calculation is to be corrected accordingly.

8.7.4 Stresses are to be determined proceeding from the greatest vibration or stress amplitudes measured in the respective section of the torsiogram or oscillogram.

When estimating the total stresses due to vibration of several orders, the registered parameters are to undergo harmonic analysis.

8.8 RESTRICTED SPEED RANGES

8.8.1 Where the shaft stresses, torques in some installation components or temperature of rubber components of flexible couplings arising due to torsional vibration exceed the relevant permissible values for continuous running determined in accordance with 8.2.1, 8.3.1, 8.4 to 8.6, restricted speed ranges are assigned.

8.8.2 No restricted speed ranges are allowed for the following rotation speeds:

$n \geqslant 0{,}9n_r$ for the main engines;

$n = (0{,}9 - 1{,}05)n_r$ for diesel generators and other essential auxiliary diesel installations. For the main diesel generators of ships with electric propulsion plants, all fixed speed values corresponding to the specified conditions of partial loading are alternately to be adopted for n_r.

8.8.3 If all other methods of lowering stresses (torques) due to torsional vibration prove ineffective, a vibration damper or antivibrator may be fitted where the values permitted by 8.2 to 8.6 are exceeded:

in case of continuous operation, within speed ranges where restricted speed range is not allowed or undesirable;

in case of rapid passage, in any point of the speed range $(0 – 1{,}2)n_r$.

8.8.4 The vibration damper or antivibrator is to ensure lowering of stresses (torques) by not less than 85 per cent of the relevant permissible values at the resonance to which it is adjusted.

8.8.5 Within the speed range of main engines $(0{,}9 – 1{,}05)n_r$ and diesel generators, vibration dampers or antivibrators may be used to eliminate restricted speed ranges on a special consideration by the Register in each case.

8.8.6 A restricted speed range is determined proceeding from the speed range in which the stresses (torques, temperature) exceed the permissible values increased by 0,02 of n_{res} on both sides.

For calculation purposes, the restricted speed range borders may be determined by the following formula:

$$16n_{res}/(18 - n_{res}/n_r) \leqslant n \leqslant (18 - n_{res}/n_r)n_{res}/16 \qquad (8.8.6)$$

where n_{res} = resonance speed, in rpm.

8.8.7 Restricted speed ranges are to be marked off on the tachometer in accordance with 2.4.2.

Information on restricted speed ranges and their borders is to be given on plates displayed at all stations from which the installation may be controlled.

8.8.8 In case of remote control of the main machinery from the wheelhouse, an arrangement is to be provided to prevent continuous running of machinery within the restricted speed ranges.

PART VII. SYSTEMS AND PIPING

1 GENERAL

1.1 APPLICATION

1.1.1 The requrements of the present Part apply to the following shipboard systems and piping:

.1 bilge and drain;
.2 ballast, heel and trim;
.3 cargo;
.4 liquefied gas;
.5 toxic media;
.6 steam and blow-down systems of boilers;
.7 feed water and condensate;
.8 fuel oil;
.9 lubricating oil;
.10 cooling water;
.11 compressed air;
.12 air, venting, overflow and sounding;
.13 exhaust gas;
.14 ventilation;
.15 open-ended steam lines from safety valves;
.16 cleaning and washing of tanks;
.17 hydraulic drives;
.18 containing organic coolants.

Special requirements for systems other than those stated above are set out in the relevant Parts.

Systems and piping of berth-connected ships are to comply with the requirements of the present Part of the Rules as far as applicable and sufficient unless expressly provided otherwise below.

1.1.2 Fuel oil used on ships is to comply with the requirements of 1.1.2, Part VI "Machinery Installations".

1.1.3 Machinery and other components of the systems indicated in 1.1.1 are to remain operative under environmental conditions specified in 2.2, Part VI "Machinery Installations".

1.1.4 Pumps, fans, compressors and their electric drives used in the systems covered by the requirements of the present Part are to comply with the requirements of Part VIII "Machinery", and Part IX "Electrical Equipment".

1.2 DEFINITIONS

1.2.1 In the present Part the following definitions have been adopted:

Fittings are stop, regulating and safety devices, intended for motion control, consumption distribution and regulating of other parameters of the conveyed medium by means of entire or partial closing of flow section.

Pipeline fire resistance is the ability of pipeline to maintain strength and functional properties within the set period of time at flame exposure.

System is a combination of pipelines, machinery, equipment, devices, appliances and reservoirs intended for performance of certain functions providing the ship's operation.

Pipeline is a combination of pipes, fittings, formed components, pipe joints, any internal and external linings, insulation coatings, fastening elements and components for protection of pipes, intended for conveying of liquid, gaseous and compound media, as well as for transmission of pressure and sound waves.

Essential pipeline is a pipeline which damage may result in a combustible medium spillage in the machinery spaces, flooding, toxic media leakage, failure of the system ensuring the operation of main and auxiliary engines, loss of run or control.

Pipelines formed components are bends, t-pieces, bulkheads and deck sockets and other components of pipelines, intended for pipelines branching, changing of conveyed medium direction and ensuring of hull structures tightness.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions relating to classification procedure, technical supervision during ship construction and surveys, as well as requirements for technical documentation to be submitted to the Register for reveiw and approval are set forth in General Regulations for the Classification and Other Activity, in Part II "Technical Documentation" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships and in Part I "Classification" of the present Rules.

1.3.2 Proceeding from the type and characteristics of the media conveyed, pipelines are subdivided into three classes as shown in Fig. 1.3.2 and Table 1.3.2. Test categories, types of joints, welding procedures and heat treatment are determined proceeding from the pipeline class.

1.3.3 Pipelines, Class I and Class II pipeline fittings, bottom and side fittings, remote-controlled fittings, venting fittings, air pipes covers, flexible joints (including expansion joints), as well as the valves on the forepeak bulkhead, are subject to the Register technical supervision during manufacture.

Table 1.3.2

Piping system for	Class I ($p > p_2$ or $t > t_2$)	Class II	Class III ($p<p_1$ or $t<t_1$)
Toxic and corrosive media	Without special safeguards[1]	With special safeguards[1,2]	—
Inflammable media heated above flash point or having flash point below 60 °C[3], liquefied gases	Without special safeguards[1]	With special safeguards[1]	—
Steam[4]	p > 1,6 or t > 300	Any pressure and temperature combination except the values indicated for Classes I and III	$p \leqslant$ 0,7 and $t \leqslant$ 170
Thermal oil[4]	p > 1,6 or t > 300		$p \leqslant$ 0,7 and $t \leqslant$ 150
Fuel oil, lubricating oil and hydraulic oil[4]	p > 1,6 or t > 300		$p \leqslant$ 0,7 and $t \leqslant$ 60
Other media[4,5,6]	p > 4,0 or t > 300		$p \leqslant$ 1,6 and $t \leqslant$ 200

1 Safeguard for reducing leakage possibility and limiting its consequences at the Register satisfaction.
2 Not applicable to ammonia and other toxic media.
3 Cargo oil pipes belong to Class III.
4 p = design pressure, MPa;
t = design temperature, °C (refer to 2.3.1).
5 Including water, air, gases, non-flammable hydraulic fluids.
6 For open-ended pipes (drains, overflows, vents, exhaust gas lines, boiler escape pipes) irrespective of the temperature, Class III pipes may be used.

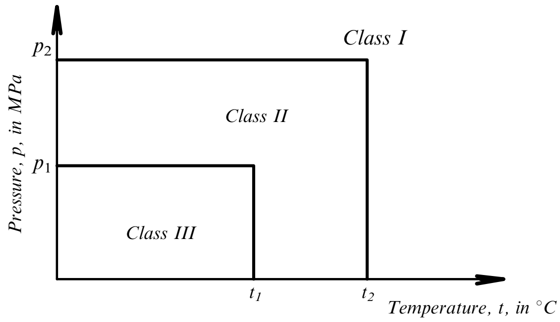


Fig. 1.3.2

1.4 PROTECTION AND INSULATION OF PIPELINES

1.4.1 Insulation of pipelines.

Insulation of pipelines is to comply with the requirements of 4.6, Part VI "Machinery Installations".

1.4.2 Protection against corrosion.

1.4.2.1 Steel pipes of sea water, as well as air, sounding and overflow pipes of water tanks and tanks for alternate carriage of water ballast and fuel oil, cargo tank vents and air pipes of cofferdams on oil tankers, are to be protected against corrosion upon completion of bending and welding work by a method approved by the Register.

Zinc coating may be used as such protection. In this case, zinc coating of pipes is to be applied by a hot method upon completion of pipe bending and all welding. The minimum thickness of zinc coating layer is to be not less than 50 micron. Depending on the purpose of pipelines, the Register may require that the coating thickness is increased. Aluminium coatings of pipelines are allowed in ballast tanks, in inerted cargo tanks, as well as in dangerous areas on the open deck, provided they are protected against accidental impacts. Application of zinc coatings does not supersede the measures for protection of pipelines against contact corrosion.

1.4.2.2 Where bottom and side fittings of non-ferrous metal alloys are used, provision is to be made for cathodic protection of the ship's shell plating and all components coming into contact with those fittings against contact corrosion. Cathodic protection of welded suction and discharge branch pipes against contact corrosion is to be made with the use of standard ring end or ring flange protectors to be mounted on branch pipe flanges. The use of electric insulating joints of the mating components made in accordance with the approved standards is allowed; in this case, bottom and side fittings are to be insulated on both sides with the obligatory measuring of the joint insulation resistance upon completion of installation.

1.4.2.3 Where steel pipelines of sea water systems are connected to fittings, pump casings, machinery units and heat exchangers of non-ferrous metal alloys, provision is to be made against contact corrosion.

1.4.3 Protection against excessive pressure.

1.4.3.1 The pipelines in which pressure exceeding of design pressure is likely to arise, are to be fitted with arrangements preventing the pressure rising above the design pressure of the pipeline.

Escape of fuel oil from relief valves of pumps handling flammable liquids is to be laid to the suction chamber of the pump or to the suction pipeline. This requirement does not apply to centrifugal pumps.

1.4.3.2 Where provision is made for a reducing valve on the pipeline, a pressure gauge and a safety valve are to be installed after the reducing valve. An arrangement for by-passing the reducing valve is allowed for use.

1.5 WELDING AND NON-DESTRUCTIVE EXAMINATION OF WELDS

1.5.1 Welding and non-destructive testing of welds in pipelines are to be effected in compliance with the requirements Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

1.6 MACHINERY, EQUIPMENT AND CONTROL DEVICES

1.6.1 Pumps, fans, compressors and their electric drives used in systems described in the present Part are to comply with the requirements of Part VIII "Machinery" and Part IX "Electrical Equipment" of the Rules.

1.6.2 Control and monitoring devices of systems are to comply with the requirements of Part X "Automation" of the Rules.

1.6.3 Heat exchangers and pressure vessels used in the systems are to comply with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

2 METAL PIPELINES

2.1 MATERIAL, MANUFACTURE AND APPLICATION

2.1.1 The materials used for pipes and fittings, as well as the methods of testing the materials are to comply with the requirements of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

Materials for pipes, fittings and drives, intended for especially corrosive media, are to be considered by the Register in each case. Fuel oil pipelines are to be manufactured of steel or other materials complying with the Register requirements for their strength and fire-resistance.

These requirements apply also to lubricating oil pipelines conveying other flammable petroleum products including hydraulic and thermal liquids if they are located in spaces containing sources of ignition.

2.1.2 In general, pipes and fittings of carbon steel and carbon-manganese steel are to be used for media with temperature not exceeding 400 °C, of low alloy steel – with temperature not exceeding 500 °C.

These steels may be allowed for temperatures higher than above mentioned, if their mechanical properties and ultimate long-term strength meet the current standards and are guaranteed by the steel manufacturer as suitable for the high temperature service.

Pipes and fittings for media with temperature above 500 °C are to be manufactured of alloy steel. This requirement does not cover exhaust pipelines.

2.1.3 Copper and copper alloy pipes are to be seamless pipes or of other type approved by the Register.

Copper pipes for Class I and Class II pipelines are to be seamless.

Pipes and fittings of copper and copper alloys are generally to be used for media having temperature not exceeding 200 °C, and those of copper-nickel alloys, for temperature not over 300 °C (refer to Table 2.3.5.3). Bronze fittings may be allowed for media having temperatures up to 260 °C.

2.1.4 Spheroidal or nodular graphite cast iron may be allowed for pipes and fittings of bilge, ballast and liquid cargo pipelines within double bottom or cargo tanks.

The use of such pipes and fittings in other locations, as well as for Class II and Class III pipelines for other services are subject to special consideration by the Register in each case.

Spheroidal graphite cast iron fittings may be allowed for media with temperature not over 350 °C.

Side fittings and branches, bottom fittings, as well as fittings referred to in 4.3.2 and valves on collision bulkhead, fuel oil and lubricating oil tanks may be allowed to be of spheroidal graphite cast iron of fully ferric structure in accordance with Table 3.9.3.1, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

2.1.5 Grey cast iron pipes may be used for cargo pipelines inside cargo and slop tanks.

Pipes and fittings of grey cast iron may be also used for cargo pipelines with pressures up to 1,6 MPa on the weather deck, except for the end fittings of cargo pipeline for connection to the loading/discharge hoses.

The use of grey cast iron for pipes and fittings of Class III pipelines for other services are subject to special consideration by the Register in each case. However, it is not to be used for:

.1 pipes and fittings handling media with temperature above 200 °C;

.2 pipes and fittings subject to water hammer, excessive strain and vibrations;

.3 pipes directly connected to shell plating;

.4 valves and fittings fitted on shell plating and on collision bulkhead;

.5 valves under static head, fitted on external walls of fuel oil and lubricating oil tanks, unless protected against mechanical damage by a method approved by the Register;

.6 fittings of systems containing thermal liquids.

2.1.6 The application of pipes and other system components made of aluminium alloys in systems mentioned under 1.1.1 is subject to special consideration by the Register in each case.

2.1.7 Application of plastic pipes is to comply with Table 3.3.1.2.

2.1.8 Flexible joints (hoses).

2.1.8.1 The type and design of flexible joints used for systems listed in 1.1.1 are to be approved by the Register (refer to 2.5, Part VIII "Systems and Piping" of Rules for the Classification and Constructions of Sea-Going Ships). The material of flexible joints is to be selected with regard to the applicable media to be conveyed, pressures, temperatures and environmental conditions. Disruptive pressure of flexible joints (except ventilation systems) is to be at least 4 times higher than the design pressure.

2.1.8.2 In the pipelines conveying fuel oil, lubricating oil and other flammable liquids, as well as in pipelines connected with the drives of watertight doors or with the openings in shell plating only fire-resistant flexible joints supplied as fabricated inserts with connecting items (flanges or screwed nipple unions) are allowed for use. No clamping arrangements are allowed. Where such flexible joints are installed in machinery spaces of Category A the possibility of their disconnection in case of damage is to be provided. Disconnecting valves are to be located in readily accessible places in the immediate vicinity of flexible joints so that any flexible joint can be replaced without stopping other machinery.

2.1.8.3 A joint is considered fire-resistant if, being connected to a pipeline in which water is circulating at a temperature not less than 80 °C at the maximum working pressure, it withstands fire for 30 min at a temperature of 800 °C and its integrity is preserved during and after a proof pressure test. An alternative to this test are the above-mentioned fire tests with circulating water pressure equal to 0,5 MPa with further hydraulic test for double design pressure.

2.1.8.4 When a flexible joint is made of steel or other equivalent material complying with the requirements of the Register for fire-resistance, fire-resistance test is not required.

2.1.9 Plugs and threaded portions of deck sockets of sounding pipes terminating on the open decks, are to be of bronze or brass. The use of other materials is subject to special consideration by the Register in each case.

2.1.10 Self-closing fittings of sounding pipes of double bottom fuel oil tanks are to be corrosion-resistant and are not to initiate sparks.

2.1.11 Sight-glasses on fuel oil and lubricating oil pipelines are to be refractory.

2.2 RADII OF PIPE BENDS, HEAT TREATMENT AFTER BENDING

2.2.1 Radii of pipe bends.

The inner bending radius of steel and copper pipes subjected to a pressure exceeding 0,49 MPa or a working medium temperature exceeding 60 °C, as well as bending radius of pipes with allowance for thermal expansion, is to be at least 2,5d (d = pipe outside diameter).

The inner bending radius of boilers blow-off pipelines is to be at least 3,5d_1 (d_1 = pipe inside diameter).

On agreement with the Register, bending to a lesser radius may be allowed provided no thinning of pipe wall occurs during the bending.

2.2.2 Hot bending of steel pipes is to be generally carried out at the temperature 1000 – 850 °C; however, the temperature may decrease to 750 °C during the bending.

For pipes the bending of which is carried out within this temperature range, the following applies:

.1 for C, C-Mn and C-Mo steels, no subsequent heat treatment is required;

.2 for 1Cr – 0,5Mo steel with a wall thickness greater than 8 mm, subsequent stress relieving heat treatment at the temperature 620 – 680 °C is required;

.3 for 2,25Cr – 1Mo and 0,5Cr – 0,5Mo – 0,25V steels of any thickness, a subsequent stress relieving heat treatment at the temperature 650 – 720 °C is required except for pipes with a wall thickness ⩽ 8 mm, diameter ⩽ 100 mm and the maximum service temperature up to 450 °C for which no subsequent heat treatment is required.

2.2.3 When the hot bending is carried out outside the temperature range specified in 2.2.2, a subsequent heat treatment in accordance with Table 2.2.3 is generally required.

Table 2.2.3

Type of steel	Heat treatment and temperature, in °C
C and C – Mn	Normalizing 880 to 940
0,3Mo	Normalizing 900 to 940
1Cr – 0,5Mo	Normalizing 900 to 960 Tempering 640 to 720
2,25Cr – 1Mo	Normalizing 900 to 960 Tempering 650 to 780
0,5Cr – 0,5Mo – 0,25V	Normalizing 930 to 980 Tempering 670 to 720

2.2.4 After cold bending when $r \leqslant 4$d, a complete heat treatment in accordance with Table 2.2.3 is generally required. However, in any case a stress relieving heat treatment is required for 0,3Mo steel with a wall thickness ⩾15 mm at 580 – 640 °C, 1Cr – 0,5Mo steel with a wall thickness ⩾8 mm at 620 – 680 °C and for 2,25Cr – 1Mo and 0,5Cr – 0,5Mo – 0,25V steel with a wall thickness ⩾8 mm, diameter ⩾100 mm and service temperature above 450 °C at 650 – 720 °C.

2.2.5 Copper and copper-alloy pipes, except for the pipes of measuring instruments, are to be annealed before hydraulic tests.

2.2.6 Preheating before welding and postweld heat treatment are to be carried out in accordance with 2.5.5, 2.5.6 and 2.5.7, Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

2.3 PIPE WALL THICKNESS

2.3.1 The wall thickness of metal pipes (except cast iron pipes) operating under the internal pressure is not to be less than that determined by the following formula:

$$S = \frac{S_0 + b + c}{1 - (a/100)} \qquad (2.3.1\text{-}1)$$

where $S_0 = \dfrac{dp}{2\sigma\varphi + p}$; (2.3.1-2)

S_0 = theoretical wall thickness, in mm;
d = outside diameter of the pipe, in mm;
p = design pressure determined in accordance with 2.3.2, in MPa;
φ = weld efficiency factor taken in accordance with 2.3.3;
b = allowance for a reduction of pipe wall thickness because of bending taken in accordance with 2.3.4, in mm;
σ = permissible (normal) stress determined in accordance with 2.3.5 to 2.3.7, in MPa;
c = allowance for corrosion taken in accordance with Table 2.3.1-1 for steel pipes and Table 2.3.1-2 for pipes of non-ferrous metals, in mm;
a = negative manufacturing tolerance for pipe wall thickness, in per cent (when pipes without negative allowance are used, $a = 0$).

Table 2.3.1-1

Allowance *c* for corrosion for steel pipes

Working medium, pipeline service	*c*, in mm
Superheated steam	0,3
Saturated steam	0,8
Heating steam coils for water and petroleum products in tanks and cargo tanks	2,0
Feed water in open circuit systems	1,5
Feed water in closed circuit systems	0,5
Blow-down of boilers	1,5
Compressed air	1,0
Hydraulic oil systems	0,3
Lubricating oil	0,3
Fuel oil	1,0
Cargo pipelines	2,0
Liquefied gas	0,3
Refrigerating pipelines	0,3
Fresh water	0,8
Sea water	3,0
Notes: 1. If pipes are fitted with efficient protection, then, at the discretion of the Register, the allowance for corrosion may be reduced by the value up to 50 per cent. 2. Where pipes of special steel alloys with sufficient corrosion resistance are used, the allowance for corrosion may be reduced to zero. 3. For pipes passing through tanks and on open decks the table values are to be increased by the allowance for the influence of the external medium which is assumed for the appropriate medium in accordance with the present Table.	

Table 2.3.1-2

Allowance *c* for corrosion for pipes of non-ferrous metals and alloys

Pipe material	*c*, in mm
Copper, brass, copper-tin alloys and similar alloys, except those with lead content	0,8
Copper-nickel alloys (with Ni content ⩾10 per cent)	0,5
Note. Where pipes of special alloys with sufficient corrosion resistance are used, the allowance for corrosion may be reduced to zero.	

2.3.2 The design pressure on the basis of which the calculations of pipeline strength are made is to be assumed equal to the maximum pressure of the safety valves opening. Pipelines and components of systems not protected by safety valves or which may be disconnected from their safety valves, are to be designed for the maximum possible pressure at the outlet of the pumps connected.

For pipelines containing fuel oil heated above 60 °C the design pressure is to be taken not less than 1,4 MPa.

For pipelines of steering gear the design pressure is to be assumed in compliance with 6.2.4, Part VIII "Machinery".

In particular cases, not provided by the Rules, the design pressure is subject to special consideration by the Register.

2.3.3 The strength factor in strength calculations is to be taken as 1 for seamless pipes and approved welded pipes which are considered to be equivalent to seamless pipes.

For other welded pipes the strength factor is subject to special consideration by the Register in each case.

2.3.4 The allowance for an actual reduction of pipe wall thickness because of bending is to be adopted in such a way that the stresses in the bent part of the pipe because of internal pressure does not exceed the permissible stresses.

Where precise values of thickness reduction while bending are not known, the allowance, in mm, may be determined by the following formula:

$$b = 0{,}4 S_0 \frac{d}{R} \qquad (2.3.4)$$

where R = mean radius of pipe bend, in mm.

2.3.5 In the strength calculations the permissible stresses are taken considering the following properties of material and sevice conditions:

$R_{m/20}$ = ultimate strength at room temperature, in MPa;

$R_{eL/t}$ = the minimum yield strength at the design temperature, in MPa;

$R_{0,2/t}$ = conventional yield strength at the design temperature, in MPa;

$R_{m/t}^{100\ 000}$ ultimate long-term strength for 100000 hrs at the design temperature, in MPa;

$R_{p1/t}^{100\ 000}$ = 1 per cent of creep limit for 100000 hrs at the design temperature, in MPa.The design temperature t for determining permissible stresses is taken as the maximum temperature of the medium inside the pipes. In particular cases, the design temperature is subject to special consideration by the Register.

2.3.5.1 For carbon or alloy steel pipes the permissible design stresses are assumed equal to the lowest of the following values:

$R_{m/20}/2,7$; $R_{eL/t}/1,8$ or $R_{0,2/t}/1,8$; $R_{m/t}^{100\ 000}/1,8$;

$R_{p1/t}^{100\ 000}/1,0$.

The possibility of the safety factor reduction is subject to special consideration by the Register in each case.

When the design temperature is not included in the creep limit of the material, permissible stresses on the creep limit consideration may be omitted.

2.3.5.2 The permissible stresses for high-alloyed stresses are subject to special consideration by the Register in each case.

2.3.5.3 For copper and copper-alloy pipes the permissible stresses are to be determined in accordance with Table 2.3.5.3.

2.3.6 Steam pipelines with an external diameter of 80 mm and over for superheated steam at a temperature of 350 °C and over are to be calculated for stresses caused by thermal expansion, and flanged joints – for strength and tightness.

The calculation of stresses in steam pipelines due to thermal expansion is to comply with the requirements of 18.3, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

2.3.7 The wall thickness of cast iron pipes is subject to special consideration by the Register in each case.

2.3.8 The wall thickness of steel, copper, and copper alloys pipes in all cases is to be not less than that indicated in Table 2.3.8.

2.4 PIPE JOINTS

2.4.1 The use of welded, flanged, threaded and mechanical joints, made in accordance with the standards approved by the Register, is allowed.

2.4.2 Welded joints.

2.4.2.1 Welded butt joints of full penetration type with special provisions for root side quality, for instance, performed with the use of double-sided welds, backing strap or other equivalent methods, are allowed for pipelines of any class and diameter.

Welded butt joints of full penetration type without special provisions for root side quality are allowed for Class II and III pipelines without diameter restrictions.

2.4.2.2 Slip-on sleeve and faucet welded joints may be used for Class III pipelines regardless of the pipeline diameter.

In some cases such joints may be used for Class I and II pipelines with the outside diameter up to 60,3 mm, except for the pipelines conveying toxic media and for operation under heavy fatigue loads, excessive corrosion and erosion.

2.4.3 Flange connections.

2.4.3.1 Dimensions and shape of flanges and connecting bolts are to comply with the standards approved by the Register.

The applied seals are to be compatible with the conveyed medium at the design pressure and temperature. For non-standard joints the strength dimensions of flanges and connecting bolts are subject to special consideration by the Register in each case.

2.4.3.2 Connections of flanges and pipes are to be made in accordance with Fig. 2.4.3.2.

Other types of joints may be accepted by the Register upon the special consideration.

2.4.3.3 Choice of flange and pipe joint type depending on the pipeline class is to be made in accordance with Table 2.4.3.3.

Table 2.3.5.3

Permissible stresses σ_{perm} for pipes of copper and copper alloys

Pipe material	Heat treatment	Minimum tensile strength, in MPa	σ_{perm}, in MPa, at medium temperature, in °C										
			50	75	100	125	150	175	200	225	250	275	300
Copper	Annealing	220	41	41	40	40	34	27	19	–	–	–	–
Aluminium brass	Ditto	320	78	78	78	78	78	51	25	–	–	–	–
Copper-nickel 95/5 and 90/10	Ditto	270	69	69	68	66	64	62	59	56	52	48	44
Copper-nicke 70/30	Ditto	360	81	79	77	76	74	72	70	68	66	64	62

Notes: 1. Intermediate values are to be determined by linear interpolation.
2. For materials which are not included in the Table, the permissible stresses are subject to special consideration by the Register in each case.

Table 2.3.8

Maximum wall thickness of pipes, in mm

External diameter, in mm	Pipes								
	Steel							Copper	Copper alloys
	Pipes of systems other than stated in columns 3 to 8	Air, overflow and sounding pipes of tanks	Sea water pipes (bilge, ballast, fire-extinguishing, cooling systems, etc.)	Pipelines passing through tanks (see 7.3.4)	Heating coils for petroleum products, stripping and cargo pipelines	Pipelines for CO_2 fire extinguishing systems: from cylinders to starting valves	Pipelines for CO_2 fire extinguishing systems: from starting valves to discharge nozzles		
10	1,6	-	-	-	-	-	-	1,0	0,8
16,0	1,8	-	-	-	-	-	-	1,2	1,0
20,0	2,0	-	-	-	-	-	-	1,2	1,0
25,0	2,0	-	2,5	-	-	3,2	2,6	1,5	1,2
38,0	2,0	2,5	2,5	6,3	3,0	4,0	3,2	1,5	1,2
45,0	2,0	2,5	3,0	6,3	4,0	4,0	3,2	1,5	1,2
57,0	2,3	2,5	3,0	6,3	4,5	4,5	3,6	2,0	1,5
76,0	2,6	3,2	3,5	6,3	5,0	5,0	3,6	2,0	1,5
89,0	2,9	3,2	3,5	7,1	5,0	5,6	4,0	2,5	2,0
108,0	2,9	4,0	4,0	7,1	5,0	7,1	4,5	2,5	2,0
133,0	3,6	4,0	4,0	8,0	5,6	8,0	5,0	3,0	2,5
159,0	4,0	4,5	4,5	8,8	6,0	8,8	5,6	3,0	2,5
219,0	4,5	5,0	5,0	8,8	7,0	-	-	3,5	3,0
273,0	5,0	6,0	6,0	8,8	8,0	-	-	-	-
325,0	5,6	6,3	6,3	-	9,0	-	-	-	-
370,0	5,6	6,3	6,3	-	10,0	-	-	-	-

Notes: 1. For pipes with thicknesses and diameters indicated in the Table, the nearest national and international standards values are accepted on agreement with the Register.
2. The tabulated values require no allowance for negative manufacturing tolerance and reduction in thickness due to bending.
3. The Table does not cover the stainless pipes the minimum thicknesses of which are subject to special consideration by the Register.
4. For the diameters greater than those stated in the Table, the minimum thicknesses is subject to special consideration by the Register in each case.
5. If the pipes are efficiently protected, then, at the discretion of the Register, the wall thicknesses of pipes, stated in columns 3, 4 and 5, may be reduced by an amount not more than 1 mm.
6. For sounding pipes, the thicknesses stated in columns 3 and 5 apply to the parts which are outside the tanks for which these pipes are intended.
7. For threaded pipes, the wall thickness is given for the minimum thickness at the bottom of the thread.
8. The thickness stated in columns 7 and 8 apply to the pipes which are galvanized on the inside.
9. The Table is not applicable to the exhaust gas pipelines.
10. For low pressure carbon dioxide system the wall thickness of pipes on a length from tank to discharge nozzles is to be the same as in column 8.

2.4.4 Tapered threaded connections.

2.4.4.1 Threaded slip-on sleeve connections with buttress screw thread may be applied in Class I pipelines with the outside diameter up to 33,7 mm and Class II pipelines with the outside diameter up to 60,3 mm, except systems containing toxic and flammable media and for operational conditions with heavy fatigue loads, excessive corrosion and erosion.

2.4.4.2 Application of threaded connections in CO_2 fire-extinguishing systems is allowed only inside the spaces to be protected and in CO_2 cylinders room.

2.4.5 Mechanical joints.

2.4.5.1 Mechanical joints are pipeline joints different from welded, flange or threaded connections described in 2.4.2 to 2.4.4.

The present requirements are applicable both to various screwed nipple unions ensuring rigid fixing of pipe ends, and slip-on sleeve connections which allow shifting of pipe ends in axial and/or radial directions.

The used types of mechanical joints are to be approved by the Register.

2.4.5.2 Design of mechanical joints is to exclude the possibility of their spontaneous opening under the influence of pipeline vibration, pressure and temperature fluctuations, as well as other influences, associated with operational conditions on board the ship.

2.4.5.3 In case application of the joint results in thinning of pipe wall, this is to be taken into consideration while determining the permissible pipe wall thickness for threaded connections (refer to Note 7 to Table 2.3.8).

2.4.5.4 Materials of mechanical joints are to be compatible with pipe materials and are to be resistant to the media conveyed.

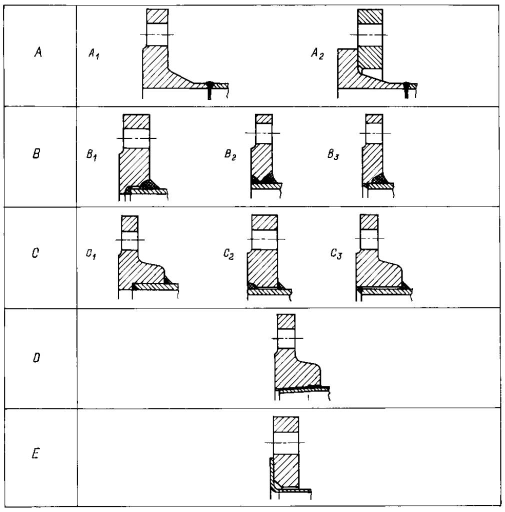


Fig. 2.4.3.2:
in tapered threaded connection of type D the outside diameter of pipe thread is not to be less than the pipe outside diameter. Where necessary, the pipe is to be flared after the flange is fitted

Table 2.4.3.3

Class of pipeline	Toxic, corrosive and combustible media, liquefied gas[3]	Fuel oil, lubricating oil, combustible hydraulic oil	Steam	Other media[1]
I	A, B [5]	A, B	A, B [2,5]	A, B
II	A, B, C	A, B, C	A, B, C, D[4]	A, B, C, D[4], E[4, 6]
III	—	A, B, C	A, B, C, D	A, B, C, D, E[6]

[1] Including water, air, gases, non-combustible hydraulic oil.
[2] Only type A when the design temperature exceeds 400 °C.
[3] Only type A when the design pressure exceeds 1 MPa.
[4] Types C_3, D and E (refer to Fig 2.4.3.2) are not to be used when the design temperature exceeds 250 °C.
[5] Type B for pipelines with outside diameter of 154,4 mm and lower.
[6] Type E — the flanging technology is to be approved by the Register.

2.4.5.5 Mechanical joints are to resist pressure 4 times exceeding the design pressure.

When the design pressure is 20 MPa and above, the test pressure value may be decreased on agreement with the Register.

2.4.5.6 As a rule, mechanical joints intended for use in systems conveying flammable media and in essential systems are to be fire-resistant.

2.4.5.7 The use of mechanical joints for direct connection to side openings or tanks with combustible liquids is not allowed.

2.4.5.8 Mechanical joints used on intake sections of pipelines are to be operable in vacuum conditions.

2.4.5.9 The number of mechanical joints is to be kept to a minimum. Their assembling is to be performed in accordance with the Manufacturer's requirements.

2.4.5.10 The possibility of mechanical joints application in cargo holds, tanks and other not easily accessible places is a matter of special consideration by the Register in each case.

The use of mechanical joints inside the tanks may be allowed when homogenous media are contained in tanks and pipelines.

2.4.5.11 Mechanical joints are to be used in compliance with the requirements of Table 2.4.5.11 depending on the pipeline class.

Table 2.4.5.11

Types of joints	Class of pipeline		
	I	II	III
Screwed nipple and nipple unions:			
soldered and welded	+[1]	+[1]	+
with a ring inserted	+[1]	+[1]	+
with a pipe flaring	+[2]	+[1]	+
Socket joints	—	+	+

Symbols: + use is allowed; - use is not allowed.

[1] For pipes with external diameter up to 60,3 mm
[2] For pipes with external diameter up to 33,7 mm.

2.4.5.12 Mechanical joints are to be tested according to the program approved by the Register. As a minimum, such tests are to include the following tests: test pressure $p_{test} = p$, vibration, fire-resistance, holding force in axial direction, operability in vacuum conditions.

The Register may assign additional checks considering the peculiarities of structure and purpose of the pipeline.

2.4.5.13 The use of other types of pipeline joints not mentioned in the present Chapter is subject to special consideration by the Register in each case.

3 PLASTIC PIPELINES

3.1 TERMS AND DEFINITIONS

3.1.1 Plastic materials are thermoplastic (thermoplasts) and thermosetting (thermosets) materials with reinforcement and without it, such as polyvinylchloride (PVC) and fibre reinforced plastic (FRP).

3.2 SCOPE OF APPLICATION. GENERAL

3.2.1 The requirements of the present Section apply to all pipelines made of plastics.

3.2.2 The requirements do not apply to flexible non-metal joints, rubber hoses, as well as to mechanical connections used in systems with metal pipes.

3.2.3 General requirements for plastic pipes and formed components are given in 6.8, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

3.3 REQUIREMENTS FOR PIPELINES DEPENDING ON THEIR PURPOSE AND LOCATION

3.3.1 Fire-resistance.

3.3.1.1 Pipes and formed components, integrity of which has significant influence on the ship's safety, are to meet the requirements of fire-resistance.

3.3.1.2 Depending on pipelines ability to maintain integrity during fire-resistance tests according to the procedure specified in Annexes 1 and 2 to the IMO Resolution A.753 (18), three levels of fire-resistance are specified:

L1: for pipelines withstanding fire-resistance test in dry condition during 1 hour;

L2: for pipelines withstanding fire-resistance test in dry condition during 30 min;

L3: for pipelines withstanding fire-resistance test in filled condition during 30 min.

The scope of application of plastic pipelines depending on fire-resistance level, location and media conveyed is given in Table 3.3.1.2.

Table 3.3.1.2

Application of plastic pipelines

Nos	Medium conveyed	Location											
		Pipelines systems	A	B	C	D	E	F	G	H	I	J	K
1	Liquid cargoes with flash point $\leqslant$ 60 °C	Cargo	—	—	L1	—	—	O	—	O[10]	O	—	L1[2]
		Crude oil tank washing	—	—	L1	—	—	O	—	O[10]	O	—	L1[2]
		Exhaust gas	—	—	—	—	—	O	—	O[10]	O	—	+
2	Inert gas	Pipeline from hydraulic lock	—	—	O[1]	—	—	O[1]	O[1]	O[1]	O[1]	—	O
		Pipeline from purifier	O[1]	O[1]	—	—	—	—	—	O[1]	O[1]	—	O
		Main pipe	O	O	L1	—	—	—	—	—	O	—	L1[4]
		Distribution pipelines	—	—	L1	—	—	O	—	—	O	—	L1[2]
3	Flammable liquids with flash point > 60 °C	Cargo	+	+	L1	+	+	—[3]	O	O[10]	O	—	L1
		Fuel oil	+	+	L1	+	+	—[3]	O	O	O	L1	L1
		Lubricating oil	+	+	L1	+	+	—	—	—	O	L1	L1
		Hydraulic	+	+	L1	+	+	O	O	O	O	L1	L1
4	Sea water	Drainage	L1[7]	L1[7]	L1	+	+	—	O	O	O	—	L1
		Drain pipelines of internal spaces	L1[4]	L1[4]	—	L1[4]	O	—	O	O	O	O	O
		Sanitary drains (internal)	O	O	—	O	O	—	O	O	O	O	O
		Drainage from weather decks	O[1, 8]	O[1, 8]	O[1, 8]	O[1, 8]	O[1, 8]	O	O	O	O	O[1, 8]	O
		Fire main and water spraying	L1	L1	L1	+	—	—	—	O	O	+	L1
		Foam fire-extinguishing	L1	L1	L1	+	—	—	—	O	O	L1	L1
		Sprinkler	L1	L1	L3	+	—	—	—	O	O	L3	L3
		Ballast	L3	L3	L3	L3	+	O[10]	O	O	O	L2	L2
		Essential cooling systems	L3	L3	—	—	—	—	—	O	O	—	L2
		Non-essential cooling systems	O	O	O	O	O	—	O	O	O	O	O
		Crude oil tank washing	—	—	L3	—	—	O	—	O	O	—	L3[2]
5	Fresh water	Essential cooling systems	L3	L3	—	—	—	—	O	O	O	L3	L3
		Condensate return system	L3	L3	L3	O	O	—	—	—	O	O	O
		Non-essential systems	O	O	O	O	O	—	O	O	O	O	O
6	Other media	Air, sounding and overflow pipes: water tanks and dry compartments	O	O	O	O	O	O[10]	O	O	O	O	O
		Flammable liquids, T_{flash} > 60 °C	+	+	+	+	+	+[3]	O	O[1]	O	+	+
		Pneumatic control systems	L1[5]	L1[5]	L1[5]	L1[5]	L1[5]	—	O	O	O	L1[5]	L1[5]
		Air pipes for domestic needs	O	O	O	O	O	—	O	O	O	O	O
		Brine	O	O	—	O	O	—	—	—	O	O	O
		Low pressure steam	L2	L2	O[9]	O[9]	O[9]	O	O	O	O	O[9]	O[9]

Table 3.3.1.2 - continued

Symbols:
A — machinery spaces of category A;
B — other machinery spaces;
C — cargo pump rooms, including entrances and trunks;
D — cargo spaces of roll-on/roll-off ships;
E — dry cargo rooms and trunks;
F — cargo tanks and trunks;
G — fuel oil tanks and trunks;
H — ballast tanks and trunks;
I — cofferdams, dry compartments, etc.;
J — accommodation, service spaces and control stations;
K — weather decks;
L1 — fire-resistance test in dry condition during 60 min;
L2 — fire-resistance test in dry condition during 30 min;
L3 — fire-resistance test in filled condition during 30 min;
O — fire-resistance test is not required;
— — not applicable;
+ — only metal materials with fusion point above 925 °C.

[1] Valves with remote control located outside the room are to be provided from the side.
[2] For cargo tanks the remotely closing valves are to be provided.
[3] When cargo tanks contain flammable liquids with flash temperature >60 °C, "O" may be used instead of "—" or "+".
[4] For drainage pipelines serving only the particular space "O" may be used instead of "L1".
[5] When control functions are not foreseen, "O" may be used instead of "L1".
[6] For the pipeline between engine room and deck hydraulic lock "O" may be used instead of "L1".
[7] For passenger ships "+" may be used instead of "L1".
[8] For scupper holes of weather decks in the positions 1 and 2 according to Regulation 13 of International Convention on Load Line, 1966, "+" is to be used, if they are not provided with with the appropriate blanking means.
[9] For essential purposes, such as heating of cargo tanks and the ship's typhon, "+" is to be used instead of "O".
[10] For tankers, where the requirements of item 3(f), Regulation 13F, Annex I, MARPOL 73/78 is to be met, "—" is to be used instead of "O".

3.3.2 Flame spreading, flame-retardant coatings.

3.3.2.1 All pipes, except for pipes located on weather decks, in tanks, cofferdams, pipelines tunnels, etc. Are to have characteristic of slow spreading of flame on the surface, not exceeding the average values fixed in IMO Resolution A.653(16) and determined according to the procedure given in Annex 3 to the Resolution considering the changes arising from curved surface of pipes or specified by other standards approved by the Register.

3.3.2.2 When fire-retardant coatings are applied to provide the required degree of fire-resistance they are to comply with the requirements of 6.8, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

3.3.2.3 Fire-retardant coatings in junctions are to be applied after carrying out hydraulic tests of the system in compliance with the pipe Manufacturer's recommendations according to the procedure approved by the Register in each case.

3.3.2.4 Fire-retardant coatings are to be used according to the approved recommendations of the Manufacturer.

3.4 INSTALLATION REQUIREMENTS

3.4.1 Supports.

3.4.1.1 Choice of supports and distances between them is to be determined depending on permissible stresses and maximum allowable pipe swag.

Distances between supports are not to exceed the values recommended by the Manufacturer.

In choosing of supports and distances between them pipe sizes, mechanical and physical properties of pipe material, mass of pipes and liquid contained in them, external pressure, working temperature, influence of thermal expansion, loads due outer forces, axial forces, hydraulic impacts, vibration, which may occur in the system, are to be taken into consideration. Allowance is to be made for the possible simultaneous effect of the above mentioned loads.

3.4.1.2 The load from pipe weight is to be equally distributed over the entire load-bearing face of the support. Measures are to be taken to minimize pipe wear at their junction with the supports.

3.4.1.3 Components of the system having significant mass, such as valves, compensators, etc. Are to be fitted with separate supports.

3.4.2 Heat expansion compensation.

3.4.2.1 When assembling plastic pipelines the compensation tolerance for relative displacement between pipelines and steel structures considering difference in heat expansion ratios and the ship's hull deformation is to be provided.

3.4.2.2 When calculating heat expansions the working temperature of the system and the temperature at which assembling is carried out are to be taken into consideration.

3.4.3 External loads.

3.4.3.1 In pipeline laying, where necessary, allowance is to be made for periodically involved concentrated loads. As a minimum, the force generated by the load of one person of 100 kg in the middle of span of any pipe with the outer diameter over 100 mm is to be taken into consideration.

3.4.3.2 To ensure the appropriate rigidity of pipelines, including pipelines with open ends, the Register may require to increase the wall thickness in comparison with thickness specified basing on strength control.

3.4.3.3 When necessary, pipes are to be protected from mechanical damage.

3.4.4 Installation of electrically conducting pipes.

3.4.4.1 In systems for transferring liquids with electrical conductivity less than 1000 pico-Siemens per meter (PS/m), such as raffinates, distillates, electrically conductive pipes are to be used.

3.4.4.2 Regardless of the liquids transferred the plastic pipes passing through explosive areas are to be electrically conductive.

Resistance in any point of the pipeline system as relative to earth is not to exceed 10^6 Ohm. Pipes and formed components having electrically conductive layers are to preferably be of equal conductivity.

Such pipes are to be sufficiently protected from damage by electric discharge caused by difference in electrical conductivity of layers.

3.4.4.3 After installation, earth connection is to be checked. Earthing wires are to be accessible for examination.

3.5 PLASTIC PIPES JOINTS

3.5.1 Strength of joints.

3.5.1.1 Strength of joints is not to be less than strength of a pipeline where they are mounted.

3.5.1.2 Pipelines may be joined with the use of glued, welded, flanged and other connections.

3.5.1.3 Glues used for assembling of pipelines are to maintain tightness of joints through the whole pressure and temperature range.

3.5.1.4 Joints are to be tightened in accordance with the instructions of the Manufacturer.

3.5.2 Testing of joint quality.

3.5.2.1 For the inspection of pipe joint quality it is necessary in accordance with the accepted procedure to prepare test assemblies which are to include at least one butt joint of pipe with pipe and pipe with formed component.

3.5.2.2 After setting of a test joint junction the hydraulic test with pressure 2,5 times higher than the design pressure is to be carried out during at least 1 hour. Leakage and breaks of joint are not allowed. Tests are to be arranged in such a way that joints are loaded both in longitudinal and transverse directions.

3.5.2.3 When selecting pipes for test specimen the following is to be taken into consideration:

when the maximum outer diameter of joint assembly is less than 200 mm, the test assembly is to incorporate a pipe with the maximum diameter;

when the maximum outer diameter of joint assembly is over 200 mm, the outer diameter of test joint assembly is to be 200 mm or to be equal to 25 per cent of the maximum diameter of the coupling, whichever is greater.

3.6 PLASTIC PIPELINES LAYING

3.6.1 Where plastic pipelines pass through watertight and fire-resistant decks and bulkheads of A or B type the requirements of 5.1 are to be met.

3.7 INSPECTION DURING INSTALLATION

3.7.1 Installation is to be carried out in accordance with the instructions of the manufacturer.

3.7.2 The method of pipe connection (junction) is to be developed and approved prior to the installation.

3.7.3 Surveys and tests stated in the present Section are to precede the method approval.

3.7.4 Personnel involved in the work is to be properly qualified and attested.

3.7.5 In the method of joint connection the following is to be reflected: the applied materials, used tools and accessories, the requirements for preparation of joints, the requirements for dimensions and tolerances, temperature conditions, as well as the acceptance criteria upon completion of work and tests.

3.7.6 Any alterations in the method resulting in change of physical and mechanical properties of the joint call for its repeated consideration and re-approval.

3.8 TESTING OF PIPELINES AFTER INSTALLATION ON BOARD THE SHIP

3.8.1 After installation essential pipeline system is to be hydraulically tested with pressure at least 1,5 times higher than the design pressure.

3.8.2 Non-essential pipeline system may be tested for tightness with the working pressure.

3.8.3 For electrically conductive pipes the availability of grounding is to be checked and a spot check of resistance for grounding is to be carried out.

4 FITTINGS

4.1 CONSTRUCTION, MARKING, ARRANGEMENT AND INSTALLATION OF FITTINGS

4.1.1 Construction.

4.1.1.1 Covers of valves with internal diameter more than 32 mm are to be secured to valve bodies by bolts or studs.

Threaded covers may be used for the valves having internal diameter up to and including 32 mm, if reliable stops are fitted on these covers.

The nut of plug in a cock is to be well locked to prevent loosening while handling the cock.

4.1.1.2 Valves with remote control except those mentioned in 4.1.1.4 are to be arranged for local manual operation independent of the remote operating mechanism.

In case of valves provided with remote control according to requirements of the present Rules, manual means operation of valves is not to render the remote control system inoperative.

If the valves are provided with remote control, they are to be so constructed that in case of failure of the remote control system, the valves remain, or automatically return, in a position that does not bring the ship in dangerous condition.

4.1.1.3 Compressed air is not to be used in remote control systems to operate actuators inside cargo tanks.

4.1.1.4 Where the valves inside cargo tanks are remote-controlled by means of a hydraulic system, they are to be also operable with the laid of a hand pump which can be connected to the hydraulic system in places where the pipes are laid down to each valve, or to a separate pipeline leading directly to the valve actuator.

4.1.1.5 The supply tank of the hydraulic remote control system of the valves inside cargo tanks is to be located as high as practicable above the level of the top of cargo tanks, and all supply pipelines of hydraulic system are to enter the cargo tanks through the highest part of the tanks.

The supply tank is also to have an air pipe laid to the safe place on the open deck and fitted with a flame-arresting gauze at the open end.

This tank is to be fitted with a low level audible and visual alarm.

4.1.2 Marking of fittings.

4.1.2.1 Shut-off fittings are to be provided with conspicuous fixed nameplates bearing clear inscriptions to show the purpose of fittings.

4.1.2.2 Remote-controlled valves at control stations are to have identification plates showing their purpose, as well as position indicators "open" and "closed".

Where the remote control is used only to close the valve, the indicators may be omitted.

4.1.3 Arrangement and installation of fittings.

4.1.3.1 The fittings arranged on watertight bulkheads are to be secured to welded pads by studs, or fitted on bulkhead pieces.

The stud holes in welded pads are not to be through holes.

4.1.3.2 Valve chests and hand-controlled valves are to be fitted in places where they are at all times readily accessible in normal operating conditions.

Where the fuel oil system valves are installed in the engine room, the valve control gear is to be fitted above the floor level.

4.1.3.3 The measuring instruments of fuel oil and lubricating oil systems are to be provided with valves or cocks to shut the instruments off from pipelines. Thermometer sensors are to be encased in compact sleeves.

4.2 FILTERS

4.2.1 The construction of filters which need maintenance is to facilitate their cleaning.

4.2.2 Filters are to be provided with a device to indicate the absence of pressure therein before they are opened.

The tubes of such devices are to be carried to trays so that spillages are not sprayed around.

4.2.3 For filters forming part of systems with a combustible working medium, an interlock is recommended so that they cannot be opened when under pressure and that the working medium cannot be supplied therein when opened.

4.2.4 Filters are to be so arranged that they are readily accessible for maintenance.

Filters forming part of systems with a combustible working medium are to be located as far away as practicable from sources of ignition.

4.3 SEA CHESTS AND ICE BOXES. BOTTOM AND SIDE FITTINGS. OPENINGS IN SHELL PLATING

4.3.1 Sea chests and ice boxes.

4.3.1.1 On ships with ice strengthening and on icebreakers, one of sea chests is to function as an ice box. Ice boxes design is to allow an effective separation of ice and removal of air from the ice box to ensure reliable operation of the sea-water system.

Sea inlet valves are to be secured directly to sea chests or ice boxes.

4.3.1.2 On icebreakers and ships with ice strengthening, provision is to be made for heating of sea chests and ice boxes as well as of side fittings above the load waterline. For this purpose the following is to be provided:

cooling water recirculation for ice boxes and sea chests;

heating medium supply through a non-return shut-off valve (for side fittings). Heating arrangements are to be so designed as to prevent the side fittings and shell plating from being damaged under the influence of lowest temperatures.

On agreement with the Register, other methods of heating the side fittings may be used.

For ice boxes, the cooling water recirculation pipes are to be laid to the upper and lower parts of the box, and the total sectional area of these pipes is not to be less than the area of the cooling water discharge pipe. For sea chests, the diameter of the cooling water recirculation pipe is to be not less than 0,85 of the discharge pipe diameter.

4.3.1.3 Provision is to be made for the access into these boxes via detachable gratings or manholes. If a manhole is provided in the ice box it is to be located above the deepest load line.

4.3.2 Openings in shell plating. Bottom and side fittings.

4.3.2.1 The number of openings in shell plating is to be kept to a minimum. Discharge pipelines, wherever possible, are to be connected to common openings.

4.3.2.2 Location of sea inlet and discharge openings in the shell plating is to be such as to prevent:

sewage, ash and other wastes being sucked by sea water pumps;

sewage and discharge water penetrating into the ship's spaces through side scuttles as well as any discharge of water into lifeboats and liferafts when lowered.

Where it is impossible to comply with this requirement, discharge openings are to be fitted with appropriate arrangements to prevent water penetration into the ship’s spaces, lifeboats and liferafts.

4.3.2.3 All the openings in shell plating of sea chests and ice boxes are to be fitted with gratings. Instead of gratings, holes or slots in the shell plating are allowed. The net area through holes or slots is not to be less than 2,5 times the clear area of the valve connected to the sea inlet. The diameter of holes and the width of slots in gratings or shell plating is to be about 20 mm. The gratings of sea chests are to be provided with a steam or compressed air connection for clearing purposes. For ice boxes, clearing arrangements may be omitted.

Clearing pipelines are to be provided with screw-down non-return valves. The pressure of steam or compressed air in the clearing system is not to exceed 0,3 MPa.

4.3.2.4 In machinery spaces, all the sea inlets and discharges of systems and pipelines serving the main and auxiliary machinery are to have readily accessible valves or sluice valves locally controlled. Controls gear is to be fitted with an indicator to show if the valve is open or closed.

Side discharge valves are to be of the non-return shut-off type. On agreement with the Register, such a valve may be replaced by a non-return valve or by a pipeline loop laid sufficiently high above the deepest load line.

4.3.2.5 Drives for operating bottom and side inlet fittings are to be located in readily accessible places and be fitted with an arrangement indicating whether the valve is open or shut.

On passenger ships, such drives are to be located above the floor level of the engine room.

4.3.2.6 In periodically unattended machinery spaces, the control gear of inlet and outlet valves of the sea water systems lying below the waterline and the control gear of the ejector drainage system are to be so arranged that they are accessible and there is enough time to activate them while the space is being flooded.

If the level to which a space can be flooded with the ship in the fully loaded condition is above the controls, provision is to be made to operate them from a position above this level.

4.3.2.7 Bottom and side fittings are to be attached to welded pads.

The fittings may be also installed on distance pieces welded to the shell plating, provided they are straight, rigid enough and have a minimum length and protection against contact corrosion. Distance pieces are to be located in readily accessible places for maintenance and for measuring of shell plating thickness under service conditions. The use of flanged joints of D and E types (refer to 2.4.3.2) is not allowed. The design of connections is to be submitted to the Register for approval.

The wall thickness of a distance piece is not to be less than the minimum thickness of shell plating in the ends of the ship, but may not to exceed 8 mm.

Stud holes in welded pads are not to be through holes.

4.3.2.8 Side and bottom fittings located below the bulkhead deck as well as their gaskets are to have no components the material of which is readily deteriorate in the event of fire.

4.3.2.9 Spindles and closing parts of bottom and side fittings are to be manufactured of corrosion-resistant materials.

4.3.2.10 The shell openings from garbage chutes of spaces located below the freeboard deck are to be provided with closing devices for preventing water penetration inboard. The closing devices are to meet the requirements of 3.2.11.1 of the Load Line Rules for Sea-Going Ships.

5 PIPELINES LAYING

5.1 PIPELINES LAYING THROUGH WATERTIGHT AND FIRE-RESISTING STRUCTURES

5.1.1 The number of pipelines laid through the watertight bulkheads is to be kept to a minimum.

5.1.2 The collision bulkhead is not to be pierced below the bulkhead deck by more than one pipeline for dealing with the contents of the forepeak.

Where the forepeak is divided by a longitudinal bulkhead into two watertight compartments, two suction pipes are allowed to be laid through the collision bulkhead, i.e. one for each compartment.

Each pipeline in double bottom space passing through the collision bulkhead is to be fitted with a shut-off valve directly on the collision bulkhead inside the forepeak, operable from a readily accessible place on the bulkhead deck.

The shut-off valve may be omitted on the pipelines passing through the collision bulkhead above the bulkhead deck or freeboard deck.

5.1.3 Where pipelines pass through watertight bulkheads, decks and other watertight structures, the appropriate sockets, welded pads and other details to ensure the integrity of the structure concerned are to be used.

The holes for studs are not to penetrate watertight structures and are to be kept within the welded pads.

Gaskets made of lead or a material readily deteriorated in the event of fire are not to be used.

Sockets attached by welding to watertight decks and bulkheads, depending on diameters, are to be increased in thickness at least by 1,5 mm the thickness of the branch pipe connected to the socket.

5.1.4 Where plastic pipes pass through watertight bulkheads and decks forming boundaries of watertight compartments, valves capable of being operated from above the bulkhead deck are to be fitted.

The valves are to be of steel or another material equivalent to steel in fire resistance.

This requirement does not apply to ballast pipes laid within double bottom.

5.1.5 Where pipelines pass through fire-resisting divisions, the requirements of Part V "Fire Protection" are to be met.

5.1.6 Where plastic pipes pass through a division of the main vertical fire zone, provision is to be made for steel sleeves of the appropriate length, with valves that may be closed from either side of the bulkhead. These valves are to be of steel or another material equivalent to steel in fire resistance.

5.2 PIPELINES LAYING IN TANKS

5.2.1 Drinking water and feed water pipelines are not to be laid through fuel oil and lubricating oil storage tanks, nor are fuel oil and lubricating oil pipelines to pass through drinking water and feed water tanks, unless the pipes are laid in oiltight ducts forming part of the tank structure.

Sea water and lubricating oil pipelines with no ducts, as well as air, overflow and sounding pipes may pass through the fuel oil storage tanks, if these pipes are of seamless type and have no detachable joints inside the storage tanks; where detachable joints cannot be avoided, they are to be flanged with oilproof gaskets placed between them.

5.2.2 Where the pipelines passing through the tanks are not carried in ducts and thermal expansion is to be considered, pipe bends are to be arranged inside tanks.

Where pipelines are laid in ducts, it is recommended to arrange thermal compensators outside the duct.

5.2.3 The pipelines laid on oil tankers are to comply with the requirements of 8.2.

5.3 PIPELINES LAYING IN CARGO HOLDS AND OTHER SPACES

5.3.1 Pipelines are to be secured in a way as not to cause excessive stresses from thermal expansion, undue deformation of ship structure and vibration.

5.3.2 Pipelines passing through cargo holds, chain lockers and other spaces in which they are subject to mechanical damage are to be adequately protected.

5.3.3 Fuel oil, steam and water pipes as well as pressure pipelines of hydraulic drives are not, as a rule, to be laid in dry cargo holds. This requirement does not cover bilge pipes.

In exceptional cases, which are subject to special consideration by the Register, these pipelines may be allowed in ducts provided the pipes used are of increased thickness and protected by strong steel casings.

5.3.4 Steam pipelines are not to be laid in paint rooms or other spaces intended for the carriage of readily flammable materials.

5.3.5 Where hot pipelines pass through bulkheads made of combustible materials, structural measures are to be taken to prevent the bulkheads from being affected by increased temperature.

5.3.6 Pipelines conveying fuel oil are not to be laid through the accommodation and service spaces as well as under the lining, except for fuel oil pipeline of the emergency diesel-generator and filling pipelines, which are allowed to be laid through sanitary spaces, provided the pipes used have a thickness of not less than 5 mm and no detachable joints are employed.

5.3.7 Pipelines conveying hot media and having considerable longitudinal extension are to have thermal compensators or sufficient number of bends to provide adequate self-compensation of the pipeline.

The radii of bends are to be in compliance with the requirements of 2.2.1.

5.3.8 Pipelines of all systems and vent ducts are, where necessary, to be fitted with arrangements for blow-down of the working medium or draining of liquid.

The appropriate structural measures are to be taken to protect the ship's structure and equipment from adverse effect of the agents discharged.

5.3.9 The pipes of fire extinguishing systems are to be laid in compliance with the requirements of Section 4, Part V "Fire Protection".

5.3.10 Group I and II refrigerant piping laying through accommodations and service spaces is to be carried out in compliance with 6.2.8, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships.

5.4 PIPELINES LAYING IN REFRIGERATED CARGO SPACES

5.4.1 It is recommended not to lay pipelines through refrigerated cargo spaces, unless they are intended to serve these spaces. Where laying of such pipelines cannot be avoided, they are to be carefully insulated. This requirement equally applies to air and sounding pipes. In these spaces the pipelines are not to have sections in which water may collect and freeze.

5.5 PIPELINES LAYING IN THE VICINITY OF ELECTRICAL AND RADIO EQUIPMENT

5.5.1 Pressure pipelines are not allowed to be carried above and behind the main and emergency switchboards as well as control panels of essential machinery and equipment.

Such pipelines may be carried at a distance not less than 500 mm from the fronts and sides of these switchboards and control panels, provided that at a distance less than 1500 mm from switchboards and control panels no detachable joints are used, or the flanged joints have protective casings.

5.5.2 Laying of pipelines through special electrical spaces (refer to Part IX "Electrical Equipment") and also through accumulator battery rooms is not allowed, except for fire smothering pipelines, compressed air pipelines and the pipelines serving the electrical equipment installed in these spaces.

5.6 PIPELINES LAYING IN UNATTENDED MACHINERY SPACES

5.6.1 Class I pipelines conveying fuel oil and lubricating oil are to have welded joints. Detachable joints are allowed to be used, but their number is to be kept to a minimum; if necessary, protective casings are to be provided in places where detachable joints are fitted.

5.7 PIPELINES LAYING ON TWIN-HULL SHIPS

5.7.1 When routed along the common upper deck, the pipelines connecting identical systems of both hulls are to be provided with compensators where necessary and protected against damage.

Damage to these pipelines are not to involve failure of the systems connected by them.

6 BILGE SYSTEM

6.1 PUMPS

6.1.1 Each self-propelled ship with propulsive power of 220 kW and above is to be provided with at least two power driven bilge pumps one of which is to be a stationary pump connected to the bilge system.

Independent ballast (except for segregated ballast), sanitary or general service pumps of sufficient capacity may be used as bilge pumps. One of the bilge pumps may be a main engine driven pump, as well as a water or steam ejector, provided the steam boiler is always in operation.

If fire pumps are used as bilge pumps, the requirement of 4.3.2.3, Part V "Fire Protection" is to be met.

6.1.2 Each self-propelled ship with propulsive power of less than 220 kW is to be provided with at least two bilge arrangements; one of these arrangements may be a stationary power pump or an ejector; while the other arrangement may be a hand pump with a capacity not less than that specified in Table 6.1.4. The use of a portable power pump instead of the stationary one is subject to special consideration by the Register.

On ships of less than 25 m in length, having no water fire fighting system, one hand bilge pump may be installed. In this case, compartments may be drained using flexible hoses.

6.1.3 Non-self-propelled ships and berth-connected ships provided with power sources or supplied with power from shore are to be equipped with bilge arrangements as self-propelled ships with main engines of power output less than 220 kW.

Ships having no oil-fired boilers, except oil barges, may be provided with hand bilge pumps. The hand pump is to have a capacity not less than 3,5 m^3/hr.

Non-self-propelled unmanned ships may be drained by the facilities of the push-tug or the roadster.

6.1.4 For drainage of non-self-propelled manned ships having ho power-driven machinery, it is sufficient to install one or several hand pumps of reciprocating type with a total capacity not less than that specified in Table 6.1.4.

Table 6.1.4

0,8 LBD[1], in m^3	Total pump capacity, in m^3/hr.
Up to 50	4
50 to 200	6
More than 200	8

[1] Definitions of L, B, D (length, breadth and depth), in m, are given in Part II "Hull". D is measured in each particular case up to the deck level.

6.1.5 Centrifugal bilge pumps are to be of self-priming type, or alternatively the system is to be provided with vacuum arrangement.

It is recommended to install one bilge pump of the reciprocating type.

6.1.6 Each bilge pump required in 6.1.1 and 6.1.2 is to have a capacity determined on the assumption that the rated speed of water in the bilge main, the diameter of which is determined by the formulae given in 6.2.1 and 6.2.2 with regard to 6.2.5, is not less than 2 m/s under normal service conditions.

The capacity of bilge pump Q in m^3 per hour is to be not less than that determined according the following formula:

$$Q = 6 \times 10^{-3} \times d^2 \qquad (6.1.6)$$

where d = inner diameter of the main determined in accordance with 6.2.1.

One of the bilge pumps may be replaced by two pumps with a total capacity not less than that specified above.

6.1.7 On ships with twin hulls, provision is to be made for an independent bilge system for each hull which is to comply with the relevant requirements of the present Chapter.

6.2 PIPELINES DIAMETERS

6.2.1 The internal diameter d_1, in mm, of the main bilge line and that of bilge suctions directly connected to the pump, except specified in 6.2.3, is to be determined by the following formula:

$$d_1 = 1{,}5\sqrt{L(B+D)} + 25. \qquad (6.2.1\text{-}1)$$

On industrial ships having hopper space, the internal diameter of the bilge main and bilge suctions directly connected to the pump may be determined by the following formula:

$$d_1 = 1{,}5\sqrt{L(B+D) - l_1(b+D)} + 25 \qquad (6.2.1\text{-}2)$$

where l_1 = length of hopper space, in m;
b = mean width of hopper space, in m;
for L, B, D refer to 6.1.4.

6.2.2 The internal diameter d_0, in mm, of branch bilge suctions connected to the bilge main, and that of hand pump suction are to be determined by the following formula:

$$d_0 = 2{,}0\sqrt{l(B+D)} + 25 \qquad (6.2.2)$$

where l = length of the compartment to be drained, as measured at its bottom, in m;
for B, D, refer to 6.1.4. In case of twin-hull ships, B is assumed to be the breadth of one hull.

6.2.3 The internal diameter of the main bilge line and bilge suctions determined by the Formulae (6.2.1-1) or (6.2.1-2) and (6.2.2) is not to be less than 40 mm. On ships of less than 20 m in length, this value of the internal diameter may be reduced. The internal diameter of the main bilge line and of the bilge suctions directly connected to the pump, in any case, are to be not less than the bilge pump suction diameter.

6.2.4 The cross-sectional area of the pipeline, connecting the distribution chest with the bilge main is to be not less than the total cross-sectional area of two largest branch bilge suctions connected to the chest, but it is to be not greater than the sectional area of the bilge main.

6.2.5 On oil tankers and other ships on which bilge pumps are intended for draining the engine room only, the cross-sectional area of the bilge main is to be not less than twice the cross-sectional area of the branch suction, the diameter of which is determined by the Formula (6.2.2).

6.2.6 The diameter of the emergency bilge suction in the engine room is not to be less than that of the pump suction.

6.3 PIPELINES LAYING

6.3.1 Bilge pipelines and their branch suctions are to be so arranged as to enable any watertight compartment to be drained by any of the pumps required in 6.1.1 and 6.1.2. This requirement does not apply to spaces of ammonia refrigerating machinery, peaks, pump rooms and cofferdams of oil tankers, drained by individual pumps, as well as to the tanks intended only for storage of liquids.

Drainage of spaces not connected to the bilge system is to be carried out by the drain pipes laid to the drained spaces or by hand pumps, compliance with the requirements of 6.10.2 is also to be provided.

6.3.2 The system is to be arranged so as to prevent the possibility of sea water penetrating inside the ship, or from one watertight compartment into another, in case of pipe break or any other pipe damage in any other compartment because of collision or grounding. For this purpose, suction valves of the drainage pipeline open ends, connected directly to the chests, are to be of non-return type. In case the only general pipeline system for all pumps is available, provision is to be made for the possibility to control the required valves serving suction branch pipes from the places above the bulkhead deck. Other equivalent arrangements are allowed.

6.3.3 Arrangement of bilge pipelines is to be such as to ensure the possibility engine rooms draining through the suctions directly connected to the pump, the other compartments being simultaneously drained by other pumps.

6.3.4 Arrangement of bilge pipelines is to be such as to enable one of the pumps to be operated in case the rest are inoperative or used for other purposes.

6.3.5 Where one main line laid from the pump located in the engine and boiler room, forward and aft, is provided for drainage, non-return shut-off valves installed on the branch pipes laid to the compartments to be drained are to be controlled from the bulkhead deck.

6.3.6 In general, the bilge pipelines are to be laid outside the double bottom. Where it is necessary to lay these pipelines through the tanks for storage of fuel oil, lubricating oil, boiler feed water and drinking water, they are to meet the requirements of 5.2. Where the pipeline is laid within the double bottom, bilge suctions in each watertight compartment are to be fitted with non-return valves.

6.3.7 On each self-propelled ship with main engines of total power output 220 kW and above, provision is to be made for emergency bilge drainage of engine rooms, in addition to the suctions required by 6.3.3. For this purpose, the cooling water pump of maximum capacity is to be fitted with direct bilge suction pipes located at the drainage level of the engine room and fitted with non-return shut-off valves. The diameter of this suction is to be of the same size as the suction branch of the pump.

Where the pumps specified above are not suitable for connection of emergency bilge suction, such a suction is to be provided from the largest available power pump which is not a bilge pump. The capacity of this pump is to exceed that required in 6.1.6 by an amount satisfactory to the Register.

The diameter of the emergency bilge suction is to be not less than that of the pump suction branch.

Spindles of the non-return shut-off valves fitted to suction branches are to extend above the engine room floor plates to a sufficient height and are to have nameplate "For emergency drainage only".

The use of fire pumps for emergency bilge drainage of engine rooms is to be in compliance with Part V "Fire Protection".

6.3.8 On ships where the use of portable drainage arrangements or drainage by means of the facilities of the push-tug is allowed, the compartments may be drained through the deck manholes with the use of a flexible hose if no cargo is available under the manholes, or through the permanent suction risers terminating in a deck socket and a branch pipe to which a hose is connected.

6.3.9 Oily-water separating and filtering equipment is to be used for purification of water before discharging overboard. The installation and operation of such equipment are not to interfere with normal functioning of the bilge and ballast systems.

6.3.10 Arrangement and the number of bilge suctions are to be determined depending on the shape and size of compartments. At least two bilge suctions are to be provided in each compartment to be drained. Short and narrow compartments may be provided with one bilge suction if it ensures efficient drainage of the compartment.

Bilge suctions are to be arranged in each compartment in such a manner as to ensure complete drainage of the compartment with the ship being heeled 5° either way.

6.3.11 In watertight compartments bilge suctions are to be fitted on both sides of the compartment. In compartments where the rise of floor exceeds 5° and in the ship's ends bilge suctions are to be fitted near the centre line.

6.3.12 Lengthwise, bilge suctions are to be arranged in the following manner:

on ships operating in upright position – near the aft bulkheads of forward compartments;

on ships operating with a trim by stern – near the aft bulkheads of compartments.

6.4 DRAINAGE OF MACHINERY SPACES

6.4.1 The arrangement and the number of bilge suctions in the engine and boiler rooms are to comply with 6.3.9 to 6.3.12. One of the bilge suctions is to be connected directly to an independent bilge pump. On passenger ships each of the independent bilge pumps located in machinery spaces, is to have two bilge suctions arranged on both sides of these spaces.

6.4.2 Suctions for bilge drainage of machinery spaces and tunnels are to be fitted with readily accessible mud boxes. Pipes between mud boxes and bilges are to be as straight as practicable. The lower ends of these pipes are not to be fitted with strum boxes. Mud boxes are to have covers that may be easily opened. The total cross-sectional area of the mud box opening is to be not less than twice the clear area of the given suction pipe.

On ships of less than 25 m in length strum boxes may be used instead of mud boxes provided they are accessible for cleaning.

6.4.3 No strum boxes or strainers are to be fitted on the suction for emergency bilge drainage.

6.4.4 Machinery spaces with double bottom are to be fitted with bilge wells of a capacity not less than 0,2 m^3.

6.4.5 On ships having an electric propulsion plant drainage of bilge wells under the propulsion motors and automatic alarms to give warning at excess of permissible level in the wells are to be provided.

It is recommended to provide automatic drainage of bilge wells.

6.4.6 The space of ammonia refrigerating machinery is to have an independent bilge system. Where a water spraying system is provided in this space, the bilge pump capacity is to be not less than the water discharge for spraying. The discharge pipeline of the bilge system is to be laid directly overboard.

The space for freon refrigerating machinery may be drained through the bilge system of the ship.

6.5 DRAINAGE OF TUNNELS

6.5.1 Each shaft tunnel and each accessible pipeline tunnel are to be drained by a bilge suction located in the aft part of the tunnel.

Where required, additional suctions are to be provided in the fore part of the tunnel. Bilge suctions of the shaft tunnel are to be made in compliance with the requirements of 6.4.2.

6.6 DRAINAGE OF CARGO SPACES

6.6.1 Each cargo space, where the double bottom forms bilges at the wings, is to have at least one bilge suction in the aft part of the hold at each side of the ship.

6.6.2 Where the length of the hold exceeds 35 m, bilge suctions are to be fitted in the fore and aft parts of this hold. At narrow ends of cargo spaces, one bilge suction may be allowed.

6.6.3 Drain pipes from spaces located below the bulkhead deck and communicating with the cargo space in the same compartment may be laid into the bilge wells of that cargo space.

Drainage into the bilges of cargo spaces from the spaces located in other watertight compartments is not allowed.

6.6.4 Where a ceiling or removable covers are fitted over the bilges or wells in cargo spaces, provision is to be made for free access of water into the bilges or wells.

6.6.5 Branch bilge suctions are to be fitted with strum boxes or strainers having perforations of 8 to 10 mm in diameter. The total area of these perforations is to be not less than twice the clear area of the given suction pipe.

The strum boxes and strainers are to be removable, or provision is to be made for cleaning them without disassembling the suction. The boxes are to be protected against corrosion.

6.7 DRAINAGE OF SPACES ON OIL TANKERS

6.7.1 Cargo pump rooms of oil tankers are to be drained by separate pumps or ejectors arranged in these spaces. Stripping pumps may be used as bilge pumps, provided non-return shut-off valves are fitted at the open ends of bilge suctions and a shut-off valve is arranged on a pipeline connecting the valve chest and the stripping pump.

Pump rooms of oil tankers up to 500 gross tonnage may be drained by hand pumps.

Construction of the pumps is to preclude the possibility of spark formation to a maximum.

Arrangement of the driving machinery of the pumps is to meet the requirements of Part VI "Machinery Installations".

Cargo pump rooms are to be provided with a high bilge water level alarm to give audible and visible warning to the cargo control station and navigating bridge.

6.7.2 For draining of fore compartments on oil tankers, provision is to be made for a separate pump or ejector which may also be used for filling and draining of tanks intended solely for water ballast.

6.8 DRAINAGE OF REFRIGERATED CARGO SPACES

6.8.1 Provision is to be made for drainage of water from all spaces, trays, chutes and other places which may accumulate water.

6.8.2 Drain pipes from non-refrigerated spaces are not to be laid into the bilges of refrigerated spaces.

6.8.3 Each drain pipeline of refrigerated cargo spaces is to be fitted with a liquid sealed trap or with another equivalent arrangement. The head of liquid is to be such that the arrangement works effectively under all service conditions.

The liquid sealed traps are to be located in accessible places outside the insulation. Where drain pipes from the 'tween-deck spaces and the holds are laid into a common bilge well, non-return valves are to be fitted to the open ends of the drains from the holds.

6.8.4 No shut-off valves are to be fitted on the drains from refrigerated spaces.

6.9 DRAINAGE OF COFFERDAMS

6.9.1 Cofferdams filled with water are to be provided with drainage arrangements. The location of branch suctions is to comply with the requirements of 6.6. On oil tankers and combination carriers, the filled cofferdams adjoining cargo tanks or slop tanks are to have independent drain arrangements.

6.10 DRAINAGE OF FOREPEAK AND AFTERPEAK AND OTHER SPACES

6.10.1 Where the peaks are not used as water ballast or other tanks, they may be drained by their own hand pumps or water ejectors. The pumps are to be located above the freeboard deck.

6.10.2 Drainage of the steering machinery rooms and other compartments located above the afterpeak may be carried out by hand pumps or water ejectors, as well as through drain pipes laid into the bilges of shaft tunnel or engine room. Drain pipes are to be fitted with readily accessible self-closing valves and are to be not less than 39 mm in diameter.

On passenger ships, drain pipes are not allowed for drainage of the above-mentioned spaces.

6.10.3 The afterpeak may be drained through a drain pipe into the bilges or drain well of the adjacent compartment. The drain pipe is to have a self-closing valve fitted on the afterpeak bulkhead on the adjacent compartment side.

6.10.4 On berth-connected ships and on ships of less than 25 m in length, the peaks may be drained by transfer of water from these compartments to the adjacent ones, provided that the gate valves fitted to the bulkheads of the peaks are operated from the deck.

6.10.5 Drainage of chain lockers and boatswain's stores may be carried by means of hand pumps, water ejectors or other arrangements.

6.11 DRAINAGE OF CARGO SPACES INTENDED FOR THE CARRIAGE OF DANGEROUS GOODS

6.11.1 Enclosed cargo spaces intended for the carriage of flammable liquids with flash point below 23 °C or toxic liquids are to be equipped with independent fixed drainage system located outside the engine room.

6.11.2 The internal diameter of the main bilge line and that of the bilge suctions directly connected to the pump is to be determined by the Formula (6.2.1-1).

6.11.3 The Register may allow the use of the ship's main drainage system for the drainage of such spaces, if the design prevents accidental pumping of flammable or toxic liquids through the pipelines and pumps of the engine room.

6.11.4 The capacity of the independent drainage system connected to the general ship's system is to be at least 10 m^3/h when one space is drained and at least 25 m^3/h when two and more spaces are drained.

6.11.5 Cargo spaces may be drained by gravity overboard or into a closed drainage tank located outside the engine room.

6.11.6 Cargo spaces are allowed to be drained into bilge wells of the underlaying spaces if these spaces satisfy the requirements imposed upon similar cargo spaces.

6.11.7 Container ships of open type are to be fitted with independent fixed hold drain system located outside the engine room.

7 BALLAST, HEEL AND TRIM SYSTEMS

7.1 PUMPS

7.1.1 The ballast system is to be served by at least one pump. The capacity of the ballast pump is to be such as to ensure the speed of water not less than 2 m/s, with the suction pipe diameter determined by the Formula (7.2.1) for the largest ballast tank.

For each hull of a twin-hulled ship, an independent ballast system is to be provided.

7.1.2 General service pumps of sufficient capacity, including bilge, fire or standby cooling pump, may be used as ballast pumps (refer to 7.1.3).

The use of fire pumps may be allowed if the requirement of 4.3.2, Part V "Fire Protection" is met.

7.1.3 Where fuel oil tanks are generally used as ballast tanks, the use of standby pump as a ballast pump or the ballast pump as a standby cooling pump or fire pump is not allowed.

7.1.4 The pumps used for pumping out ballast water from double-bottom tanks are to be of self-priming type.

7.2 PIPELINES DIAMETERS

7.2.1 The internal diameter d_i, in mm, of ballast pipelines suctions for separate tanks is to be determined by the following formula:

$$d_i = 16\sqrt[3]{v} \tag{7.2.1}$$

where v = ballast tank capacity, in m^3.

The diameter may be adopted to the nearest standard size.

7.2.2 The diameter of the ballast main is not to be less than the maximum diameter of the suction determined by the Formula (7.2.1).

7.3 PIPELINES LAYING

7.3.1 The arrangement of suctions is to be such as to ensure pumping of water from any ballast tank, whether the ship is upright or heeled to 5°.

7.3.2 On icebreakers and ships with ice strengthening, the forepeak and afterpeak, as well as structural wing tanks for water ballast, located above the waterline and in way of cargo holds, are to be provided with heating arrangements. It is recommended to fit double-bottom ballast tanks in way of cargo holds with heating arrangements.

7.3.3 Suction and discharge pipelines of segregated ballast tanks are not to communicate with sea chests and pipelines serving cargo tanks.

7.3.4 Ballast, sounding and vent pipelines of segregated ballast tanks are not to pass through cargo tanks. Cargo and other pipelines intended for serving cargo and slop tanks (refer to definitions of Part V "Fire Protection") are not to pass through segregated ballast tanks. Exemptions to this requirement may be granted for short pipelines, provided they are all-welded or equivalent, with thickened flanged connections, the number of which is to be kept to a minimum. Thermal expansion is to be compensated by pipe bends. The bend radii are to comply with the requirements of 2.2.1. The wall thickness of the pipes is to be not less than indicated under column 5 of Table 2.3.8.

8 CARGO PIPING SYSTEM OF OIL TANKERS. OIL RECOVERY SYSTEM OF OIL RECOVERY SHIPS

8.1 PUMPS AND THEIR DRIVES

8.1.1 Cargo pumps and cargo stripping pumps are to serve only their designated purpose, except cases specified in 6.7.1. These pumps are not to have any connections to tanks other than cargo tanks.

Cargo and cargo stripping pumps are to be arranged in a separate space or be submerged.

8.1.2 The arrangement of cargo and stripping pump driving machinery is to comply with the requirements of Part VI "Machinery Installations".

8.1.3 The construction of pumps, fittings and pump driving machinery is to preclude spark formation to the maximum. Measures are to be taken to limit the zero delivery time of submersible cargo pumps.

8.1.4 Arrangements are to be provided for stopping each cargo pump and cargo stripping pump from the top flat of the pump room located at the main deck level or from a readily accessible place on the deck.

Where main cargo control room is provided, stopping arrangements for pumps are to be also fitted therein.

Electrically driven stopping devices are to comply with the requirements of Part IX "Electrical Equipment".

8.1.5 The pressure gauges of cargo oil discharge and cargo stripping mains are to be placed at the pumps and on the top flat of the pump room or at the main cargo control room.

8.2 PIPELINES LAYING

8.2.1 The ends of filling pipes inside cargo tanks are to be carried as near the bottom of these tanks as is practicable but not less than 1/4 of the internal diameter of the pipe.

The cargo oil pipelines are not to be carried through the tanks not intended for cargo oil and are not to be connected to other tanks or pipelines, including fuel oil pipelines of the machinery installation.

Cofferdams are not to have any connections to cargo oil tanks. Cargo transfer valves are not allowed to be fitted inside cofferdams.

Pipelines of systems in which different grades of cargo oil may become mixed or contaminated by water are to have duplicate isolating valves.

8.2.2 Remote-controlled valves are to meet the requirements of 4.1.1.2 to 4.1.1.5.

The spindles used to operate valves placed inside the tanks are to be carried to the open deck through gastight sealing glands. Replacement of the seals is to be made from the open deck. The drives are to have arrangements showing whether the valve is open or closed.

The drives are to be so constructed as to prevent accumulation of oil residues therein.

8.2.3 The temperature of steam or heating medium (in enclosed spaces) inside the cargo area is not to exceed 220 °C.

8.2.4 Flanges and fastening pieces on pipelines intended for connection of hoses from shore, are to be made of materials precluding spark formation.

8.2.5 Pipelines on the deck and in cargo tanks are to be efficiently secured and fitted with thermal compensators.

8.2.6 All the sections of the cargo pipeline interconnected by flanges are to have a reliable electrical connection and one electrical contact with the ship's hull at one place minimum.

8.2.7 Remote-controlled valves fitted between cargo mains and pumps are also to be capable of being manually operated.

The rubbing parts of valve drives passing inside cargo tanks and cofferdams, as well as on cargo deck, are to preclude spark formation.

8.2.8 Slop tanks of oil tankers are normally to be served by a separate pipeline system. Where such system is not provided, spectacle flanges or other blanking arrangements are to be fitted on all suction and filling pipelines of slop tanks.

8.2.9 On combination carriers, reliable arrangements are to be provided for isolating the pipeline connecting the pump room with the slop tanks.

The arrangement of isolation is to consist of a valve followed by a spectacle flange or a spool piece with appropriate blank flanges. This arrangement is to be located adjacent to the slop tank, but if this is unreasonable or impracticable it may be located within the pump room immediately after the place where the pipeline penetrates the bulkhead.

On combination carriers in the dry cargo mode, the system for transfer of slops to the open deck is to be a permanent installation. This system is to generally have no connection to other systems. Connection to other systems by means of removable branches is subject to special consideration by the Register in each case.

The slop transfer manifold on the open deck is to be provided with a shut-off valve and a blank flange.

8.2.10 On combination carriers, where cargo wing tanks are provided, the underdeck cargo pipelines are to be installed inside these tanks. However, the Register may allow cargo pipelines to be placed in special ducts which are to be capable of being adequately cleaned and ventilated to the satisfaction of the Register.

Where cargo wing tanks are not provided, the underdeck cargo pipelines are to be placed in special ducts.

8.2.11 In order to prevent spreading of flame into cargo holds, materials which easily lose their properties under the effect of heat are not to be used for fittings, cargo pipelines and venting arrangements.

8.3 HEATING OF CARGO TANKS

8.3.1 As a heating medium for heating of cargo tanks, the use of steam, hot water and organic coolants is allowed.

Application of other coolants is subject to special consideration by the Register in each case.

8.3.2 Upstream of each steam heating coil a non-return shut-off valve is to be fitted, and upstream of stop fittings at the outlet a control device for testing of condensate quality is to be installed.

8.3.3 The return of condensate from the heating system is to be performed via a check tank.

Air pipes of the check tank of heating steam condensate from the cargo tanks containing cargo with the flash point below 60 °C are to be provided with flame arresters and be laid to a safe place.

8.3.4 Thermal fluid systems for tank heating are to be used with regard to the requirements of 18.11 of the present Part.

8.3.5 The maximum heating temperature is to be lower than the flash point of the carried cargo having flash point > 60 °C by at least 15 °C.

8.3.6 The heating system is to be equipped with the arrangements for control of cargo temperature in tanks. Control of the current temperature in tanks, as well as visible and audible alarms on exceeding the maximum permissible cargo temperature or on decrease of flow when cargo is pumped through the heaters, is to be provided.

8.3.7 The steam temperature in the heating system of cargo pump rooms is not to exceed 220 °C.

8.4 OIL RECOVERY SYSTEM OF OIL RECOVERY SHIPS

8.4.1 The system and arrangements for the recovery and transfer of oil are to be installed outside machinery and accommodation spaces.

8.4.2 The system is to ensure both recovery and transfer of oil being recovered.

8.4.3 Where, on multi-purpose ships, the fixed oil recovery system is incompatible with the cargo of the installed cargo system, the appropriate isolating arrangements are to be provided.

8.4.4 Where the ship is fitted with portable oil recovery equipment, not more than two suctions connected by pipelines to all oil collecting tanks are to be provided on the upper deck for connecting to the discharge hoses of oil recovery equipment.

The arrangement of the suctions on the upper deck is to make it possible to simultaneously connect two oil recovery systems installed at the opposite sides of the oil recovery ship.

Pipelines connecting suctions to tanks are not to pass through accommodation spaces or spaces located as high as the open deck.

Laying of pipelines through enclosed intrinsically safe spaces is subject to special consideration by the Register in each case.

8.5 BOW AND AFT LOADING SYSTEM OF OIL TANKERS

8.5.1 The bow and aft cargo pipelines of oil tankers are to be permanently installed. Where necessary, connections of such pipelines may be detachable.

8.5.2 Bow and aft cargo pipelines are to be laid outside accommodation and service spaces, and outside machinery spaces located in way of accommodation spaces and control stations.

8.5.3 Connections of bow and aft cargo pipelines are to be welded. If necessary, expansion joints may be used. Within the cargo area, pipelines may have detachable joints.

For pipe-to-valve connections, flange connections mentioned in 2.4 may be used. Cargo pipelines of this type are to be marked accordingly and be disconnectable either with two valves in the cargo zone provided with devices for their sealing when shut (readily checkable for efficient shutting) or with one valve used alongside another closure ensuring reliable pipeline disconnection, such as detachable branch.

8.5.4 The pipeline section used as shore connection is to be fitted with a shut-off valve and a blank flange, and provided with a tray. If a special coupling is used the blank flange may be omitted.

8.5.5 In the cargo pipeline, arrangements for the discharge of cargo residues are to be provided. Cargo pipeline outside the cargo zone is to be fitted with arrangements for cleaning of cargo and filling it up with inert gas. Between cargo pipeline and inert gas system an isolating device is to be provided.

8.6 INERT GAS SYSTEMS FOR DRY CARGO SHIPS AND OIL TANKERS CARRYING DANGEROUS GOODS

8.6.1 The inert gas system is to be capable of maintaining a permanent minimum pressure of 7 kPa

(0,07 bar) in the spaces to be inerted. In addition, the inerting facility is not to increase the pressure in the cargo tank to a pressure greater than that at which the pressure valve is regulated. The pressure to which the vacuum valve is regulated is to be 3,5 kPa.

8.6.2 A sufficient quantity of inert gas for loading or unloading is to be on board or is to be capable of being produced if it is not possible to obtain it on shore. Besides, a sufficient quantity of inert gas to offset normal losses occurring during carriage is to be on board.

8.6.3 Spaces to be inerted are to be fitted with connecting pipes to supply inert gas and monitoring devices so as to ensure the correct atmosphere on a permanent basis.

8.6.4 If inert gas pressure or concentration in the gaseous phase falls below the set value, the monitoring device is to give a visual or audible alarm in the deckhouse. When the deckhouse is unattended the alarm is to be accepted in the place where one crewmember is present.

9 AIR, VENTING, OVERFLOW AND SOUNDING PIPES

9.1 AIR PIPES

9.1.1 Each tank intended for the storage of liquid (except cargo tanks specified in 9.2), each filled cofferdam, as well as ice boxes and sea chests, are to have air pipes intended for communication with the atmosphere and meeting the requirements of the present Chapter.

Air pipes of ice boxes and sea chests are to have shut-off valves fitted directly on the boxes.

Air pipes of double bottom tanks adjoining the shell plating, as well as air pipes of ice boxes and sea chests, are to be carried above the bulkhead deck.

9.1.2 Air pipes of tanks are to be fitted at the highest parts of the tanks and, as a rule, at maximum distance from the filling pipeline. The number and arrangement of pipes are to be determined depending on the shape and size of the tank, and are also to preclude air pockets formation.

If air pipes of fuel oil tanks are used as overflow (air/overflow) pipes, the requirements of 9.4 are to be met.

9.1.3 The tanks extending from side to side of the ship are to be fitted with air pipes at either side. The air pipes are not to be used as filling pipes, except when the tank is fitted with more than one air pipe.

The air pipes of tanks carrying liquids of different kinds are not allowed to be joined.

9.1.4 The height of air pipes from the deck to the level to which liquid may have access from below is to be not less than 250 mm. Air pipes are to be located in places where there is no possibility of their damage during cargo handling operations.

9.1.5 The upper end of each pipe is to be made as a bend, with its opening faced downwards or is to have another construction agreed upon with the Register.

9.1.6 On oil tankers, the open ends of air pipes of cofferdams, fuel oil and lubricating oil tanks adjoining directly the cargo and slop tanks are to be laid to places on the open deck where the issuing vapours do not present a fire hazard and are to be fitted with flame arresters of a type approved by the Register. The clear area of flame arresters is to be not less than the cross-sectional area of air pipes.

9.1.7 Air pipes of independent lubricating oil tanks not fitted with heating arrangements, may terminate in spaces where the tanks are installed; in this case measures are to be taken to preclude spillage of oil onto electrical equipment or heated surfaces in case the tank is overflowing.

9.1.8 Outlets of air pipes located on the open decks are to have permanently attached automatically operating covers preventing the sea water from penetrating the tanks, but allowing a free access of air and liquid.

9.1.9 The total cross-sectional area of air pipes in tanks filled by gravity is to be not less than the total sectional area of the filling pipes of these tanks.

9.1.10 The total cross-sectional area of air pipes of the tank filled by the ship's pumps or shore pumps, is to be not less than 1,25 times the cross-sectional area of the filling pipeline of the tank.

The cross-sectional area of a common air pipe from several tanks is to be at least 1,25 times the area of the common filling pipeline of these tanks, the requirements of 9.4.3 being met.

9.1.11 Where a tank filled by shipboard or shore pumps is fitted with an overflow pipe, the total cross-sectional area of air pipes of the tank is to be not less than one-third of the filling pipeline area.

Where air pipes from several tanks fitted with overflow pipes are combined, the cross-sectional area of the common air pipe is to be at least one-third of the area of the common filling pipe of these tanks, the requirements of 9.4.3 being met.

9.1.12 Notwithstanding the requirements of 9.1.11, an inner air pipe diameter in all cases is to be at least 40 mm for water tanks and 50 mm for other tanks.

9.1.13 The arrangement of air pipes is to preclude formation of hydraulic seals in the pipes.

9.1.14 The air pipes of fuel oil and lubricating oil tanks in way of accommodation and refrigerated cargo spaces are not to have detachable connections.

9.1.15 Nameplates are to be attached to the upper ends of all air pipes.

9.1.16 Air pipes from crankcases of internal combustion engines are to comply with the requirements of 2.3.4, Part VIII "Machinery" of the Rules.

9.1.17 The air pipes of all oil fuel tanks are to be led to 0,50 m above the open deck. Their open ends and the open ends of the overflow pipes leaking to the deck are to be fitted with a protective device consisting of a gauze grid or a perforated plate.

9.2 VENTING SYSTEM OF OIL TANKERS AND COMBINATION CARRIERS

9.2.1 Each cargo tank is to have a vent pipe intended to maintain safe pressure and gas exchange during loading, discharge and carriage of liquid cargo.

Vent pipes are to be connected to the highest part of that tank and are not to be connected to pipelines of other systems, except cargo vapour discharge system.

Vent pipes are to be so constructed as to allow the measurement of pressure in cargo tanks and pressure drop at flame arresters.

9.2.2 Vent pipes my be combined into one or several main lines. Such combination is allowed only for vent pipes from tanks containing similar cargoes.

The internal diameter of separate vent pipes is to be not less than 80 mm and that of combined lines, not less than 100 mm.

The cross-sectional area of vent pipes is to be not less than 1,25 times the cross-section of the filling pipeline of tanks. The cross-sectional area of the main vent pipeline leading from several tanks is to be not less than 1,25 times the cross-section of the common filling pipeline of these tanks.

9.2.3 Outlets of vent pipes communicating with the atmosphere are to be fitted with flame arresters of a type approved by the Register. The clear area of the flame arresters is not to be less than the sectional area of the vent pipe.

Where vent pipes are combined into a common main line, the pipes leading from each tank are to be fitted with flame arresters of a type approved by the Register. The flame arresters are to be so located that they do not be overrun by cargo liquid under any service conditions, including seaway.

Flame arresters are to be made of material resistant to corrosion. Flame arresters are to be so constructed that they can be replaced or disassembled without dismounting of vent pipes.

9.2.4 Vent pipes from cargo tanks are to be laid to the open deck subject to the following requirements:

.1 on ships intended for the carriage of petroleum products with a vapour flash point below 45 °C the outlets of vent pipes are to be located at a height of at least 1/3 of the ship's breadth above the main deck; the height may not exceed 5 m, but it is to be not less than 3 m;

.2 on ships intended for the carriage of petroleum products with a vapour flash point from 45 to 60 °C the outlets of vent pipes are to be located at a height of not less than 2,4 m above the deck;

.3 on ships intended for the carriage of petroleum products with a vapour flash point of 60 °C and above the outlets of vent pipes are to be located at a height of not less than 600 mm above the deck.

The outlets of vent pipes are to be located as far as possible from deckhouses, superstructures and air intakes, but not less than 3 m for the cases indicated in 9.2.4.1 and 9.2.4.2, and not less than 1 m for the case indicated in 9.2.4.3.

9.2.5 The pressure-vacuum valves fitted to vent pipes are to be so designed and set that the pressure in cargo tanks is not more than 20 kPa, unless the tanks have been especially designed for higher pressure, and does not drop by more than 2 kPa below the atmospheric pressure.

9.2.6 The vent pipe fitted with a pressure-vacuum valve is to have a by-passing line with shut-off fittings or other structural measures are to be provided to prevent the tanks being subjected to excessive pressure or vacuum during the cargo handling operations.

9.2.7 Venting systems of boiling petroleum products which have a Reid vapour pressure greater than atmospheric, are subject to special consideration by the Register.

9.2.8 On combination carriers such arrangements as spectacle blank flanges for isolating slop tanks from cargo tanks are to be provided.

Each enclosed space adjacent to cargo or slop tanks is to be arranged for mechanical ventilation which may be effected by portable fans.

9.3 CARGO VAPOUR DISCHARGE SYSTEM

9.3.1 The requirements of the present Chapter apply to cargo vapour discharge systems of oil tankers and chemical carriers equipped with such systems at the Shipowner's request.

9.3.2 Cargo vapour discharge system is to be arranged so that not to interfere with the normal operation of venting system.

9.3.3 Cargo vapour discharge system is to be designed basing on the maximum capacity of loading. The pressure drop in the cargo vapour discharge pipeline, obtained by means of hydraulic calculation, is not to exceed 80 per cent of the opening pressure of any relief valve of venting system.

9.3.4 Instruction approved by the Register is to be constantly kept on the ship by which the allowable loading rate of different cargoes may be defined considering the requirements of 9.3.2 and 9.3.3.

9.3.5 Vapours of incompatible cargoes are not to be mixed when passing via the vapour collecting and discharge system.

9.3.6 When the inert gas distributive pipeline is used for collecting cargo vapours, isolation of inert gas pipes from the cargo vapour discharge system is to be provided.

9.3.7 Provision is to be made for removal of liquid condensate which may be accumulated in the system.

9.3.8 Pipelines of the system are to be electrically continuous and have efficient earthing.

9.3.9 Cargo vapour discharge manifolds are to be fitted with a pressure sensor and alarm system to produce warning signal at high level (when the pressure is not higher than the lowest pressure value at which the high-speed venting device is actuated) and at low level (at the pressure closest to the atmospheric pressure at which the vacuum valve is actuated).

9.3.10 In way of the cargo vapour discharge manifold connections an easily accessible shut-off valve with manual control is to be installed.

9.3.11 Hoses used in the vapour discharge system are to meet the requirements of 6.1.12, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

9.3.12 To prevent an incorrect connection of vapour discharge pipeline to shore-based terminal liquid cargo pipeline, studs with the diameter of 12,7 mm and with the length not less than 25,4 mm are to be mounted on the vapour discharge connecting flanges, in the uppermost point of the coupling bolt line, as shown in Fig. 9.3.12-1. The vapour discharge manifold marking is to comply with Fig. 9.3.12-2.

9.4 OVERFLOW PIPES

9.4.1 Fuel oil tanks are to be provided with overflow pipes directing fuel oil to an overflow tank or storage tank the capacity of which is to be not less than that of the overflow tank as stipulated in 9.5.1 and which is to be equipped in accordance with 9.5.2.

Overflow pipes may be omitted if fuel oil system is so designed that no spilling overboard can occur during the loading and transfer of fuel oil.

9.4.2 The cross-sectional area of overflow pipes is to be as indicated in 9.1.9 to 9.1.12 for air pipes.

Where it is highly probable that the fuel can congeal in the pipeline, the Register may require the cross-sectional area of overflow pipes in heavy fuel tanks to be increased.

9.4.3 Where overflow pipes from several integrated tanks located in different watertight compartments are laid to a common header or pipe, this header or pipe are

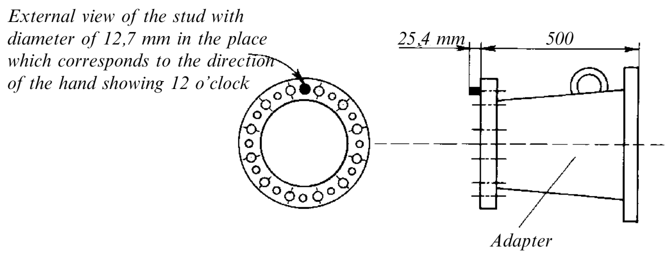


Fig. 9.3.12-1

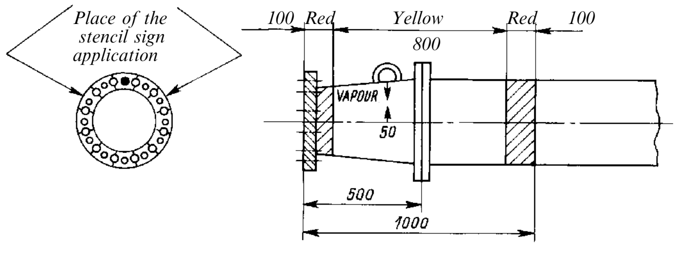


Fig. 9.3.12-2

to be located above the deepest damage waterline on ships having a subdivision mark in the class notation and above the deepest load waterline on other ships.

9.4.4 Where air pipes are simultaneously used as overflow pipes, they are not to be connected to the air pipe of the overflow tank. In this case, overflow pipes or a common overflow pipe are to be connected directly to the tank.

9.4.5 Where a tank is used alternately for the carriage of fuel oil, water ballast or liquid and dry cargoes, then in case of a common overflow system overflow pipes are to be so arranged as to preclude the possibility of liquid flowing from one tank into another and liquid cargo vapours entering tanks containing dry cargo. In such cases, on agreement with the Register overflow pipes may be fitted with shut-off valves provided such pipes are not used as air pipes.

9.4.6 Overflow pipes of fuel oil and lubricating oil daily and settling tanks are to be laid to tanks located below the tanks mentioned above.

9.4.7 A sight glass is to be fitted on vertical sections of overflow pipes in a readily visible and accessible place, or a signalling device to give warning when the predetermined level is reached in the overflow tank is to be provided (refer also to 9.5.2).

9.4.8 Minimum overflow pipe bore is to be 50 mm.

9.4.9 Overflow pipes are to be extended to the bottom of overflow tanks with a minimum clearance. The clear area of the clearance is not to be less than the cross-sectional area of the overflow pipe.

9.5 OVERFLOW TANKS

9.5.1 The capacity of the overflow fuel oil tank is not to be less than the maximum permissible throughput capacity of the fuel oil filling and transfer system within 10 min.

9.5.2 An overflow tank is to be provided with audible and visual alarms operating whenever the tank filling reaches 75 per cent.

9.6 SOUNDING ARRANGEMENTS

9.6.1 Each tank intended for the storage of liquid, cofferdams and void spaces with bilge connections, as well as bilges and bilge wells in spaces which are not accessible at all times is to be provided with sounding pipes generally extended to the open decks. Other sounding arrangements of design approved by the Register may be used on tanks.

Sounding pipes of independent tanks are not always required to be laid to the open deck.

Upper ends of sounding pipes of fuel oil and lubricating oil tanks are not to be laid to the spaces which may present a risk of ignition of leakages from sounding pipes. Laying of sounding pipes of fuel oil tanks to accommodation and service spaces is prohibited.

9.6.2 Other oil-level measuring arrangements may be used, provided they are protected by casing of steel or other equivalent fire-resistant material. Besides, on passenger ships, such arrangements are not to require penetration below the top of the tank and their failure or overfilling of tanks do not result in release of fuel oil.

The level indicators of fuel oil and lubricating oil tanks, fitted with transparent inserts are to be protected against damage.

Transparent inserts of fuel oil and lubricating oil tanks are to be made of flat glass or shockproof plastics which do not lose transparency under the effect of fuel oil and lubricating oil.

A self-closing cock is to be fitted at the lower end of level indicator at the connection to the tank. If the level indicator is connected to the tank below the maximum liquid level, the self-closing cock is to be fitted at the top end.

Self-closing cocks on lubricating oil tanks with a capacity below 500 l may be omitted.

9.6.3 Where the double bottom forms bilges at the wings, or the ship has a flat bottom, sounding pipes are to be installed at each side. These pipes are to be laid to positions above the bulkhead deck which are at all times accessible for taking measurements. The sounding pipes are to be as straight as practicable and are not to interfere with measuring with a sounding rod.

9.6.4 On cargo ships, sounding pipes of double-bottom tanks for the storage of fuel oil and lubricating oil are allowed to be laid to above the machinery room floor plates, or into the shaft tunnel, provided that such pipes are fitted with self-closing valves and their height is at least 0,5 m above the floor level. Below self-closing valves, self-closing test cocks are to be fitted. For independent tanks, short sounding pipes without additional closing arrangements are allowed provided the tanks are fitted with overflow pipes complying with the requirements of 9.4.7. The said pipes are not to be used as air pipes. Leading of sounding pipes of the above tanks through cargo tanks is to comply with the requirements of 7.3.4.

9.6.5 Sounding pipes of double-bottom water storage tanks are allowed to be laid into spaces below the bulkhead deck that are located above them and are accessible at all times. Such pipes are not to be fitted with self-closing cocks.

9.6.6 Provision is to be made under the open ends of sounding pipes for welded-on striking pads or other strengthening to protect the bottom plating from damage by a sounding rod.

In case of slotted sounding pipes with closed ends, adequately strong closing plugs are to be provided.

9.6.7 The internal diameter of sounding pipes is to be not less than 25 mm. Sounding pipes which pass through refrigerated spaces in which the temperature may be reduced to 0 °C and below, as well as sounding pipes of oil collecting tanks on oil recovery ships and pipes of the tanks fitted with heating arrangements are to have a internal diameter of not less than 50 mm.

9.6.8 Nameplates are to be attached to the upper ends of sounding pipes.

9.6.9 Each oil tanker equipped with a fixed inert gas system is to be provided with closed system for taking measurements of liquid level in cargo and slop tanks.

Sounding rods intended for cargo compartments of oil tankers with a vapour flash point below 60 °C are to be made of a material precluding spark formation.

9.6.10 It is recommended to fit each cargo tank on oil tankers with an overflow prevention system meeting the following requirements:

.1 be separated of sounding system of cargo tanks;

.2 give visible and audible signal to the ship's operator and to cargo control room (if available) when the predetermined high level is reached;

.3 actuate an alarm at de-energization of system or level transmitters;

.4 have the possibility of testing the alarm circuit prior to cargo operations;

.5 give a code signal for sequential switch-off of shore-based pumps or valves, or both, and valves on the ship. Signals, pumps and valves are to be switched off by the ship's operators. The use of the ship's automatically closing valves is allowed only upon the permission and on agreement with the Port Administration.

9.6.11 The ends of sounding pipes laid to the open decks are to be fitted with tight plugs complying with the requirements of 2.1.9.

The use of closures of other types is subject to special consideration by the Register in each case.

If sounding pipes project above the open deck, they are to be located at such places where they cannot be damaged, otherwise they are to have appropriate guards.

9.7 BLOWING-OFF AND VENTILATION OF SPACES IN THE CARGO AREA

9.7.1 Each cargo tank is to have two openings the dimensions and location of which are to be such as to permit effective ventilation of any part of the space. If there are no such openings it is to be possible to fill the cargo tanks with inert gas or dry air.

9.7.2 Double hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump rooms (if they exist) are to be provided with ventilation systems.

9.7.3 Any service spaces located in the cargo area below deck are to be provided with a system of forced ventilation with sufficient power for ensuring at least 20 changes of air per hour based on the volume of the space.

The ventilation exhaust ducts are to extend down to 50 mm above the bottom of the service space. The air shall be supplied through a duct at the top of the service space. The air inlets are to be located not less than 2 m above deck, at a distance of not less than 2 m from tank openings and 6 m from the outlets of safety valves.

The extension pipes, which may be necessary, may be of the hinged type.

9.7.4 Ventilators used for gas-freeing of cargo tanks and service spaces located in the cargo deck are to be designed so that no sparks may be emitted on contact of the impeller blades with the housing and no static electricity may be generated.

9.7.5 Notice boards are to be fitted at the ventilation inlets indicating the conditions when they are to be closed. All ventilation inlets of accommodation and service spaces leading outside are to be fitted with fire flaps. Such ventilation inlets are to be located not less than 2 m from the cargo area.

Ventilation inlets of service spaces in the cargo area below deck may be located within such area.

10 EXHAUST GAS SYSTEM

10.1 EXHAUST GAS PIPELINES

10.1.1 Exhaust gas pipelines are, as a rule, be laid to the open decks.

10.1.2 The exhaust gas pipes are not to be laid through the side shell plating to the atmosphere. Laying of exhaust gas pipes through the shell plating at the stern is allowed. Provision is to be made in such cases for arrangements precluding the possibility of sea water penetrating the engine.

10.1.3 On oil tankers, oil recovery ships, ships adapted for the carriage of explosive and fire hazardous cargoes (refer to Part V "Fire Protection") and on ships serving or towing the above-mentioned ships, the uptakes of boilers, main and auxiliary engines, incinerators are to be fitted with spark arresters or spark traps of the construction approved by the Register.

10.1.4 Exhaust gas pipelines are to be laid at a distance not less than 450 mm from fuel oil tanks.

10.1.5 Each main engine is to have an individual exhaust gas pipeline. Where required, departures may be allowed, which are subject to special consideration by the Register.

Exhaust gas pipelines of auxiliary engines may be connected to a common exhaust pipeline provided that the common exhaust pipeline is provided with reliable devices precluding gases of the common exhaust gas pipeline entering the pipelines of engines not actually at work and damage of any of the engines when started.

10.1.6 The waste heat boilers and the composite waste boilers, which by reason of structural features cannot be left without water when heated by exhaust gases, are to be provided with a by-pass pipeline and dampers disconnecting the boilers from exhaust gas supply, when necessary.

10.1.7 Exhaust gas pipelines of boilers, incinerators and internal combustion engines are to be thermally insulated by means of suitable insulating material, double walls or screens.

Where an insulating material is used for thermal insulation, the requirements of Part V "Fire Protection" are to be met.

Double walls or screens are not required only in such places where the possibility of their coming into contact with fuel oil or lubricating oil in case of leakage is precluded.

10.1.8 When the uptakes of main and auxiliary boilers are arranged to discharge into a common uptake, smoke dampers are allowed, provided they have arrangements to be locked open. When required, manholes and vertical ladders are to be provided in necessary places for inspection and cleaning of the uptakes and air ducts of the boiler.

10.1.9 On oil recovery ships, the outlets of exhaust gas pipelines of main and auxiliary engines, uptakes of boilers, incinerators and other equipment containing sources of ignition as well as vent openings in internal combustion engines are to be located at least 6 m above the deepest waterline, but in any case outside the dangerous zones as defined in Part IX "Electrical Equipment".

10.1.10 Exhaust gas pipelines of remotely and automatically started diesel generators are to be fitted with non-diconnectable draining devices to prevent water penetration into the engine. The devices are to be readily accessible for maintenance and clearing and are to have a drain pipe bore not less than 25 mm.

10.1.11 Exhaust gas pipes of engines, boilers and incinerators are to be fitted with thermal compensators. Where practicable, handholes and drain cocks are to be provided for cleaning.

10.1.12 Exhaust gas pipelines of boilers and internal combustion engines are to be thermally insulated by means of suitable insulating material, double walls or screens.

Exhaust gas pipelines passing through accommodation spaces or the wheelhouse are to be enclosed with a protective casing inside these spaces. The interspace between the exhaust gas pipes and protective casing is to communicate with the open atmosphere.

10.2 SILENCERS AND SPARK ARRESTERS

10.2.1 Silencers and spark arresters are to be so arranged as to allow cleaning. For this purpose they are to be fitted with appropriate handholes, drain cocks or plugs.

10.2.2 Where waste heat boilers and spark arresters of "wet" type are installed, arrangements are to be provided to prevent water penetration into the engine. Drain pipes are to be laid into the bilges of the engine room and are to have hydraulic seals.

11 VENTILATION SYSTEM

11.1 VENTILATION DUCTS AND VENTILATION HEADS, AIR INLETS

11.1.1 Generally, ventilation ducts are not be to laid through watertight bulkheads below the bulkhead deck. Where it is impracticable to avoid laying ventilation ducts through watertight bulkheads below the bulkhead deck, closures are to be provided at the penetrations ensuring watertightness and strength equal to that of the ship's local structures and operated from a place above the bulkhead deck. Where ventilation ducts are carried through more than one watertight bulkhead, the means of closure of such openings are to be power driven and be capable of being closed from the main machinery control room located above the bulkhead deck.

11.1.2 Where trankways and vertical ducts of ventilation system pass through watertight decks, they are to be watertight and equivalent in strength to adjacent hull structures within a single watertight compartment below the bulkhead deck.

11.1.3 Where ventilation ducts pass through the main fire-retarding bulkheads, they are to be fitted with steel fire dampers installed generally on the bulkheads. Fire dampers are to be capable of being locally closed from both sides of the bulkheads.

Places where dampers and their driving gear are installed are to be readily accessible and painted red. Indicators are to be provided to show whether the damper is closed or open.

Where the damper is installed not on the bulkhead, the duct between the bulkhead and the damper is to have insulation corresponding to the degree of fire integrity of the bulkhead.

11.1.4 Ventilation ducts for removal of explosion and fire-hazardous vapours and gases are to be gastight and are not to communicate with the ducts of other spaces.

Closures of these ducts are to be such as to preclude the possibility of spark formation. Outlets of the ducts, except those mentioned in 11.9.3, are to be fitted with flame arresters.

11.1.5 Ventilation ducts leading to cargo spaces, machinery spaces and other spaces fitted with fire smothering facilities are to have closing arrangements.

11.1.6 In places of possible sweating, ventilation ducts are to be properly insulated. Drain plugs are to be provided for the parts of ducts where water is likely to accumulate.

Inlets and outlets of ventilation systems are to be provided with actuators for closing them from places outside these spaces.

11.1.7 Ventilation heads of supply ducts and air inlets of ventilation systems are to be so located that the risk of drawing in air contaminated by gas, oil vapours, etc., is minimized, and penetration of sea water into ventilation ducts is precluded.

On icebreakers and ice-strenghtened ships, ventilation ducts are to be protected against penetration of snow. It is recommended to arrange air intakes on both sides of the ship and to provide them with heating arrangements.

11.1.8 Provision is to be made for closing all the main inlets and outlets of ventilation systems of spaces.

11.2 VENTILATION OF GALLEYS

11.2.1 Galleys ventilation systems are generally to be separated from ventilation systems serving other spaces.

Exhaust ducts from galley ranges are to be made of steel where they pass through accommodation spaces or spaces containing combustible materials.

Each exhaust duct is to be fitted with:

a grease trap readily removable for cleaning;

a fire damper located in the lower end of the duct.

11.3 REQUIREMENTS FOR VENTILATION OF OIL TANKERS AND COMBINATION CARRIERS

11.3.1 Ventilation inlets of accommodation spaces, service spaces and control stations are to be located on the end transverse bulkhead not facing cargo tanks, or on the side of the superstructure or deckhouse at a distance equal to at least 4 per cent of the ship's length, but not less than 3 m from the end of the superstructure or deckhouse facing cargo tanks. This distance, however, may not exceed 5 m.

Inlets and outlets of ventilation ducts for machinery spaces are to be located as far aft as possible. Special consideration is to be given to location of these vents on oil tankers arranged to load and discharge at the stern.

11.3.2 Cargo pump rooms of oil tankers are to have mechanical exhaust ventilation fitted separately for each space. This ventilation is to have sufficient capacity to give at least 20 air changes per hour based upon the gross volume of the space and to prevent the accumulation of flammable vapours in the space. Inlet ventilation of these spaces may be natural. The interlocking between the devices for starting of electric motors of cargo pumps and electric motors of fans is to meet the requirements of 19.2.4.11, Part IX "Electrical Equipment".

11.3.3 Inlets of exhaust ducts are to be located so as to provide extraction of air from below the floor plates.

The bottom framing, as well as the floor plates and gratings of the pump room are to be so constructed as not to prevent the free flow of air to the inlets of exhaust ducts.

Outside the pump room these ducts are to be gastight and, generally, are not to communicate with the ducts of other spaces.

Pump rooms are also to have an emergency ventilation operating in case of lower inlets being flooded. For this purpose, an emergency intake about 2 m above the lower grating is to be provided on the exhaust duct. This intake is to have a damper capable of being operated from the main deck and lower grating level. The damper may be omitted if the areas of inlets are chosen such that at least 20 air changes per hour are ensured through the lower inlets, and at least 15 air changes per hour through the upper inlets in case of the lower inlets being flooded.

Where the ventilation system of the pump room is used for ventilating the cargo pipeline and the communicating cargo tanks, shut-off fittings are to be provided at the connections of the ventilation duct to the cargo pipeline.

11.3.4 The construction of ventilation fans in cargo pump rooms is to comply with the requirements of 5.3, Part VIII "Machinery" and the location of their driving motors is to meet the requirements of 4.2.5, Part VI "Machinery Installations".

11.3.5 The outlets of exhaust ducts for cargo pump rooms are to be not less than 2 m remote from any opening leading into the ship's spaces which may contain a source of oil vapours ignition, and are to be so located that no contamination of air entering the inlets of ventilation systems occur.

The outlets of ventilation ducts are to be fitted with flame arresters.

Air intakes are to be located at least 2,4 m above the cargo deck and at least 5 m from any openings of cargo tanks and outlets of pressure-and-vacuum valves, and at least 10 m from the outlets of vent pipes that expel freely the vapour/air mixture or are fitted with high-speed devices.

11.3.6 On combination carriers, all cargo spaces and all enclosed spaces adjacent to cargo spaces are to be capable of being mechanically ventilated. This ventilation may be provided with portable fans.

11.4 VENTILATION OF MACHINERY SPACES AND TUNNELS

11.4.1 Ventilation of machinery spaces of category A is to be such as to ensure that when the machinery and boilers therein are operating at full load under all service conditions including heavy weather, air supply sufficient for the safety and comfort of the personnel and the operation of machinery.

The ventilation is to ensure removal of gases heavier than air from the lower zones of those spaces, from below floor plates, from where fuel oil system equipment, settling and supply tanks are installed.

Any other machinery spaces are to be adequately ventilated according to their purpose.

The requirements for the ventilation of spaces containing refrigerating machinery are given in 3.1.6 and 3.1.7, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships.

11.4.2 Shaft tunnels are to be properly ventilated. Pipelines tunnels laid in the double bottom are to have mechanical exhaust ventilation.

11.4.3 The space containing automatically started emergency diesel generator, is to be provided with an automatic arrangement to ensure air supply sufficient for the emergency diesel generator to run under full load under all service conditions when the space is closed.

11.4.4 In spaces specified in 4.2.7, Part VI "Machinery Installations", independent mechanical exhaust ventilation or a ventilation device which may be separated from the machinery space ventilation is to be installed. The construction of fans is to comply with the requirements of 5.3, Part VIII "Machinery".

11.4.5 On ships intended for the carriage of dangerous goods ventilation inlets of engines rooms and engine air intakes are to be located not less than 2 m from the protected area if air is not taken from the engine room itself (refer to 1.2, Part XIV "Requirements for Ships Carrying Dangerous Goods").

11.4.6 On ships intended for the carriage of packaged dangerous goods on dry cargo ships and in bulk on oil tankers and gas carriers (refer to 1.2, Part XIV "Requirements for Ships Carrying Dangerous Goods") additional requirements are imposed on ventilation of machinery spaces.

11.4.6.1 The combustion air required by the combustion engines which ensure propulsion is not to come from spaces protected by permanently fixed fire-extinguishing systems. This requirement is not mandatory if the ship has two independent main engine rooms with a gastight separation or if, in addition to the main engine room, there is a separate engine room installed with a bow thruster that can independently ensure propulsion in the event of a fire in the main engine room.

11.4.6.2 All forced ventilation systems in the space to be protected is to be shut down automatically as soon as the fire-extinguishing system is activated.

11.4.6.3 All openings in the space to be protected which permit air to enter or gas to escape are to be fitted with devices enabling them to be closed rapidly. It is to be clear whether they are open or closed.

11.4.6.4 Air escaping from the pressure-relief valves of the pressurised air tanks installed in the engine rooms are to be evacuated to the open air.

11.4.6.5 Overpressure or negative pressure caused by the diffusion of the extinguishing agent is not to destroy the constituent elements of the space to be protected. It is to be possible to ensure the safe equalisation of pressure.

11.4.6.6 Protected spaces are to be provided with a means of extracting the extinguishing agent. If extraction devices are installed, it is not to be possible to start them up during extinguishing.

11.4.6.7 Requirements of 11.4.6 are not mandatory for ships specified in 2.2, Part XIV "Requirements for Ships Carrying Dangerous Goods".

11.4.7 Ventilation of a closed engine room is to be arranged so that at an ambient temperature of 20 °C the mean temperature in the engine room is not to exceed 40 °C.

11.5 VENTILATION OF SPECIAL CATEGORY SPACES, CARGO SPACES INTENDED FOR THE CARRIAGE OF MOTOR VEHICLES WITH FUEL IN THEIR TANKS AND ENCLOSED RO-RO CARGO SPACES

11.5.1 These spaces are to have mechanical exhaust ventilation independent from other ventilation systems.

If individual spaces have effective closures, ventilation ducts are to be separate for each of them. Fans are to be operated from outside the ventilated spaces and are to be capable of ensuring at least:

.1 10 air changes per hour:

in cargo spaces for the carriage of motor vehicles with fuel in their tanks on passenger ships carrying more than 36 passengers;

in special category spaces on all passenger ships;

in enclosed ro-ro cargo spaces with electrical equipment in accordance with 19.3.4, Part IX "Electrical Equipment" on all ships;

.2 6 air changes per hour on all other ships.

11.5.2 The ventilation is to be such as to provide even distribution of air supply and to prevent formation of stagnant pockets.

11.5.3 The ventilation system is to be equipped with devices indicating any loss or reduction of the ventilating capacity and operation of fans. These devices are to be installed in the wheelhouse.

Instead of them, the following means may be provided:

.1 visual signal indicating the operation of each fan;

.2 interlock to permit the electric motor of the fan to start only if the ventilation duct is open;

.3 audible signal for spontaneous stop of the fan electric motor.

11.5.4 The construction of fans is to comply with the requirements of 5.3, Part VIII "Machinery".

11.5.5 Arrangements are to be provided for effective closure of the ventilation system in case of fire taking the weather conditions into consideration.

11.5.6 Ventilation ducts and their closures are to be made of steel.

11.6 VENTILATION OF CARGO SPACES ADAPTED FOR THE CARRIAGE OF DANGEROUS GOODS

11.6.1 Ventilation of each cargo hold is to be provided by means of two mutually independent extraction ventilators having a capacity of not less than five changes of air per hour based on the volume of an empty hold. The extraction ducts are to be positioned at the extreme ends of the hold and extend down to not more than 50 mm above the bottom. The extraction of gases and vapours through the duct are to be also ensured for carriage in bulk.

Ventilators are not required on ships only carrying goods packed in containers. If the extraction ducts are movable they are to be suitable for the ventilator assembly and capable of being firmly fixed. Protection is to be ensured against bad weather and spray. The air intake is to be ensured during ventilation. Supply ventilation may be natural.

11.6.2 The ventilation system of a hold is to be arranged so that dangerous gases cannot penetrate into the accommodation, wheelhouse or engine room.

11.6.3 The ventilation is to be such as to provide uniform change of air within the cargo space and to prevent formation of stagnant pockets.

The ventilation system is to be such that vapours of dangerous cargoes are removed from the upper or lower part of the space, depending on the vapours density in relation to air.

11.6.4 The construction of fans is to comply with the requirements of 5.3, Part VIII "Machinery".

Electric motors of the fans are to be of the safe type. It is not recommended to arrange them in way of gas exhaust.

Inlets and outlets of ventilation systems are to be protected by screens.

11.6.5 Ventilation heads of exhaust ducts from cargo spaces adapted for the carriage of dangerous goods are to be so located as to prevent issuing vapours or gases from penetrating other ship's spaces.

11.7 VENTILATION OF REFRIGERATED CARGO SPACES

11.7.1 The requirements for the ventilation of refrigerated cargo spaces are given in 3.3.5 to 3.3.8, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships.

11.8 VENTILATION OF FOAM FIRE EXTINGUISHING AND SMOTHERING STATIONS

11.8.1 The foam fire extinguishing and smothering stations are to be equipped with efficient ventilation.

The carbon dioxide smothering stations are to be provided with an independent exhaust and supply ventilation. Inlets of exhaust ducts are to be located in the lower part of the station.

11.8.2 High-expansion foam fire extinguishing stations are to be equipped with devices ensuring air supply in the amount sufficient for the operation of foam generators.

11.9 VENTILATION OF ACCUMULATOR BATTERY ROOMS AND BOXES

11.9.1 Accumulator battery rooms and boxes are to be provided with independent ventilation system capable of removing air from the upper part of ventilated spaces.

The exhaust ducts are to be gastight.

11.9.2 The inlet air is to be supplied into the lower part of the ventilated space.

11.9.3 The outlets of ventilation ducts are to be so constructed as to preclude penetration of sea water, atmospheric precipitation and solids.

No flame arresters are to be installed.

The discharges of exhaust ducts are to be laid to places where the issuing gases do not present a fire hazard.

11.9.4 The boxes of accumulator batteries having a charging capacity not over $2{,}0 \times 10^2 W$ may be ventilated through the openings in the lower and upper parts of the box to ensure removal of gases.

11.9.5 The rate of air flow Q, in m^3/s, for the ventilation of the accumulator battery room or box is to be not less than that determined by the following formula:

$$Q = 3{,}06 \cdot 10^{-5}\ In \qquad (11.9.5)$$

where I = maximum charging current during gas emission, but not less than 0,25 of the maximum current of the charging device, in A;
n = number of battery cells.

11.9.6 The duct cross-sectional area F, in m^2, in case of natural ventilation of accumulator battery rooms or boxes, is to be not less than that determined by the following formula:

$$F = 1{,}04Q \qquad (11.9.6)$$

where Q = the rate of air flow determined by the Formula (11.9.5),

but not less than 0,004 m^2.

11.9.7 Natural ventilation of spaces may be used in the following cases:

.1 the required amount of air, calculated by the Formula (11.9.5), is less than $2{,}36 \times 10^{-2}$ m^3/s;

.2 the angle of the duct deflection from the vertical is 45°;

.3 the number of bends of the duct does not exceed two;

.4 the length of the duct does not exceed 5 m;

.5 the operation of ventilation system does not depend on the direction of the wind;

.6 the duct cross-sectional area is taken not less than that determined by the Formula (11.9.6).

11.9.8 Where the rate of air flow determined by the Formula (11.9.5) is $2{,}36 \times 10^{-2}$ m^3/s and over, the accumulator battery room is to be provided with mechanical exhaust ventilation.

11.9.9 The internal surfaces of exhaust ducts and fans are to be protected against the effect of the electrolyte.

11.9.10 The motors of fans are not to be located in way of gas exhaust.

The construction of fans is to comply with the requirements of 5.3, Part VIII "Machinery".

11.10 VENTILATION OF SPACES ON OIL RECOVERY SHIPS

11.10.1 Ventilation systems serving dangerous and safe spaces are to be independent of each other. Spaces in zones belonging to different classes specified in Part IX "Electrical Equipment" are to be served by different systems.

11.10.2 Safe spaces and air locks are to be equipped with mechanical supply ventilation to provide excessive pressure therein as compared to adjacent dangerous spaces.

11.10.3 Provision is to be made for automatic actuation of ventilators and signalling for loss of excessive pressure in safe spaces and air locks. Alternatively, the following may be provided:

.1 visual signal of each ventilator running;

.2 interlocking to ensure the electric motor of the ventilator is switched on only when the ventilation duct is open;

.3 sound signal of spontaneous stop of electric motor of the ventilator.

11.10.4 Inlets of supply ventilation ducts are to be located outside dangerous spaces on open decks.

11.10.5 Exhaust duct openings are to be located outside dangerous spaces on the open deck.

11.10.6 Dangerous spaces in Zone 1 are to be provided with mechanical exhaust ventilation to ensure at least 20 air changes per hour. Application of ventilation systems providing 10 air changes per hour is allowed, if the system may be automatically switched over to 20 air changes per hour, when the gas concentration of (20+10 per cent) of the lower limit of the explosive range is reached in the atmosphere of the space. Dangerous spaces in Zone 2 are to be provided with ventilation to ensure at least 10 air changes per hour.

11.10.7 In dangerous spaces, the exhaust ventilation ducts are to be gastight, rigid enough and are not to pass through the safe spaces (except where ventilation ducts pass through safe spaces in the gastight tunnel).

11.10.8 In spaces and air locks ventilation systems are to be equipped with instruments to monitor the operation of ventilators and other devices mentioned in 11.10.3 and 11.10.6.

11.11 VENTILATION OF SPACES INTENDED FOR INERT GAS EQUIPMENT

11.11.1 In spaces intended for inert gas equipment of cargo tanks including generators, scrubbers, ventilators and their fittings, provision is to be made for artificial exhaust ventilation which is to ensure at least six air changes per hour as determined proceeding from the empty space volume.

Supply ventilation may be natural.

When the above equipment is installed in machinery spaces, the requirements of 11.4 is to be complied with.

11.11.2 For ventilating spaces mentioned in 11.11.1 on ships which tanks may carry toxic cargoes, in addition to the requirements given in 11.11.1, provision is to be made for artificial supply ventilation which is to ensure the number of air changes not less than specified in 11.11.1.

12 FUEL OIL SYSTEM

12.1 PUMPS

12.1.1 Fuel oil transfer power driven pump and a standby pump which may be a hand pump are to be provided for fuel oil transfer.

Any suitable pump, including the fuel oil separator pump may be used as a standby pump.

On ships with a daily consumption of fuel oil less than 1 t, a hand pump is allowed.

12.1.2 Where fuel oil tanks, including deep tanks, are regularly used also for water ballast, provision is to be made for reliable arrangements disconnecting the ballast system from these tanks when carrying fuel oil and also fuel oil system when containing water ballast.

In addition, the requirements of Part XIII "Means for the Prevention of Pollution from Ships" are to be met.

12.1.3 Fuel oil transfer pumps and separator pumps, besides local control, are to be provided with stopping devices operable from always accessible positions outside the spaces where the pumps are installed.

12.1.4 Shut-off valves are to be fitted on the pressure side and suction side of fuel oil pumps.

12.2 PIPELINES LAYING

12.2.1 In general, fuel oil pipelines are to have no communication with pipelines of other systems. Where fuel oil tanks are used also for water ballast, the requirements of 12.1.2 are to be met.

12.2.2 Pipelines conveying fuel oil heated above 60 °C are to be arranged in clearly visible and accessible positions, the number of detachable joints being reduced to a minimum.

12.2.3 Fuel oil pipelines are not to be laid above internal combustion engines, turbines, exhaust gas pipelines, steam lines (except heating steam coils), steam boilers and boiler uptakes. In exceptional cases, it is allowed to lay fuel oil pipelines above the said equipment provided that in these positions the pipelines have no detachable joints or are shielded and that in necessary places provision is made for trays preventing the spillage of fuel oil on the equipment or other sources of ignition.

12.2.4 The fuel oil suction pipelines from tanks of more than 500 l in capacity, as well as pipelines intended to equalize the level of liquid in tanks, where such tanks are located outside the double bottom, are to be provided with shut-off valves fitted directly on the tanks. These valves are to be capable of being closed from always accessible places located outside the space containing the tanks. Remote control of the shut-off valve fitted on the daily service tank of the emergency diesel-generator is to be arranged in a place separated from the control of other tanks.

If fuel oil tanks are located above the inner bottom plating and adjacent to the tunnels of shafting and pipelines or other similar spaces, the valves on those tanks may be fitted with local controls on condition that an additional valve is fitted in accessible place outside the said spaces. If the additional valve is fitted in the machinery space, it is to be be capable of being remotely closed from outside the machinery space.

Daily service tanks are recommended to be provided with quick-closing valves.

12.3 HEATING ARRANGEMENTS OF FUEL OIL

12.3.1 For liquefied fuel heating the heat-carrying agents listed in 8.3.1 may be used. In case of using electric heating appliances for fuel oil heating, the requirements of 15.3, Part IX "Electrical Equipment" are to be met.

12.3.2 Heating coils and electric heating appliances are to be fitted in the tanks as low as possible.

12.3.3 In daily service tanks and settling tanks, suction ends of fuel oil pipes are to be so located above the heating coils and electric heating appliances that the latter remain submerged as far as practicable. This requirement does not apply to stripping pipes.

12.3.4 When using steam heating coils for fuel oil and lubricating oil or heaters with other heating medium, except where the temperature of the medium being heated does not reach the temperature of ignition, the system is to be fitted, in addition to the temperature monitoring arrangements, also with alarms for high temperature or flow rate loss.

12.3.5 Fuel oil in storage tanks is not to be heated to temperatures 15 °C below the flash point of fuel oil.

Thermometers are to be installed in necessary places to monitor the temperature of the fuel oil to be heated.

12.3.6 The condensate of the heating steam is to pass through a sight device which makes it possible to monitor the cleanliness thereof.

12.3.7 The pressure of steam used for fuel oil heating is not to exceed 0,5 MPa.

12.3.8 Fuel oil in service tanks, settling tanks and any other tanks in the engine and boiler supply system may be heated above the limit specified in 12.3.5, provided:

.1 the length of air pipes from such tanks or the use of cooling devices make it possible to reduce the temperature of the issuing vapours below 60 °C, or the outlets of air pipes are to be located at a distance of at least 3 m from the source of ignition;

.2 electrical equipment is not located within the vapour space of fuel oil tanks unless it is of intrinsically safe design;

.3 the possibility of vapours from the upper part of the tank and air pipeline penetration into machinery spaces is precluded;

.4 enclosed spaces are not located directly over such fuel oil tanks, except for well-ventilated cofferdams;

.5 ends of air pipes are equipped with flame arresters.

12.4 DRAINAGE ARRANGEMENTS OF FUEL OIL TANKS

12.4.1 For draining water from daily service and settling tanks, these tanks are to be fitted with self-closing valves and pipelines connected to drain tanks.

Drain pipelines are to be fitted with sight glasses. Where trays are available, open funnels may be used instead of sight glasses.

12.5 ARRANGEMENTS FOR COLLECTION OF FUEL OIL LEAKAGE

12.5.1 Tanks, pumps, filters and other equipment are to be fitted with drip trays where there is a possibility of fuel oil leakage.

12.5.2 Drain pipes from the drip trays are to be laid into fuel oil drain tanks.

Drainage of fuel oil into the bilges and overflow tanks is not allowed.

12.5.3 The internal diameter of drain pipes is to be at least 15 mm.

12.5.4 Drain pipes are to be carried to the tank bottom with a gap the diameter of which is not to be less than 1/4 of the internal diameter of the pipe. Where the drain tank is located in the double bottom space, structural measures are to be taken to prevent penetration of water into the machinery spaces through the open ends of drain pipes in case of the shell plating damage.

Provision is to be made for signalling on fuel oil reaching the upper predetermined level in the drain tank.

12.5.5 If drain pipes from drip trays fitted in different watertight compartments are laid into a common drain tank, structural measures are to be taken to prevent water from one flooded compartment to enter the other compartment via the open ends of drains.

12.6 FILLING OF STORAGE TANKS

12.6.1 The bunkering of the ship is to be carried out through a permanent pipeline provided with fittings necessary for the filling of all the basic fuel oil storage tanks.

On twin-hulled ships, the suction pipelines are to ensure the filling of fuel oil tanks of any of the hulls as well as pumping of fuel oil from the tanks of one hull into the tanks of the other.

The end of the filling pipeline is to be carried to the tank bottom with a gap the diameter of which is to be not less than 1/4 of the internal diameter of the pipe.

12.6.2 On passenger ships, provision is to be made for special bunkering stations which are separated from other spaces, and fitted with drain pipes leading into fuel oil drain tanks.

12.6.3 Filling pipeliness of the tanks located above the double bottom are to be connected to the tanks near the top.

Where this is impracticable, the filling pipes are to be fitted with non-return valves installed directly on the tanks.

Where the filling pipe is used as a suction pipe, the non-return valve is to be replaced by a remote-controlled shut-off valve operable from an accessible place outside the space in which the tank is located.

12.7 FUEL OIL TANKS

12.7.1 The structural members of fuel oil tanks are to comply with the requirements of Part II "Hull".

12.7.2 The arrangement of fuel oil tanks in machinery spaces is to comply with the requirements of 4.3, Part VI "Machinery Installations".

12.7.3 Fuel oil tanks located on open decks and superstructure decks, as well as in other exposed places are to be protected against the action of sunrays.

12.7.4 On glass-reinforced plastic ships, fuel oil tanks are not to directly adjoin accommodation spaces. The air gap between the fuel oil tank and the accommodation space is to be effectively ventilated.

In general, fuel oil tanks are not to be located in engines rooms. If they are located in the engine room, they are to be made of steel or equivalent material (refer to 1.2, Part V "Fire Protection").

12.7.5 Fuel oil tanks are to be separated from the feed water and vegetable oil tanks by cofferdams the structural members of which are to comply with the requirements of Part II "Hull".

12.7.6 No fuel tanks are to be located forward of the collision bulkhead.

12.7.7 Fuel oil service tanks intended for direct supply of fuel oil to the main engines in unattended machinery spaces are to have a device to actuate visual and audible signal in the wheelhouse at the minimum level of fuel oil in tanks or be automatically filled.

12.7.8 Double bottoms within the hold area intended for the carriage of dangerous goods may be arranged as fuel oil tanks provided their depth is not less than 0,60 m. Fuel oil pipes and openings of such tanks are not permitted in the holds.

12.8 FUEL OIL SUPPLY TO INTERNAL COMBUSTION ENGINES

12.8.1 The equipment of fuel oil system is to be capable of supplying fuel oil duly prepared and cleaned to the extent required for the given engine.

12.8.2 The fuel oil filters fitted in the fuel oil supply pipelines to the engines are to be such that any filter can be cleaned without interrupting the operation of the engine. The filter construction is to be in compliance with the requirements of 4.2.

12.8.3 To remove air-vapour inclusions from the heated heavy fuel oil supply pipelines to fuel oil injection pumps deaerators are to be provided.

12.8.4 Where the main engines operate on different grades of fuel oil, measures are to be taken to prevent the different fuel oil grades from being mixed, as well as auxiliary engines and other consumers from being supplied with fuel oil unfit for their operation.

12.8.5 The diesel-generating sets intended for use as emergency are to be supplied with fuel oil from an independent daily service tank located in the emergency diesel generator room. Consumption of fuel oil from this tank by other consumers is not allowed. The tank capacity is to be such as to ensure operation of the diesel generator for a period specified in 9.3.1, Part IX "Electrical Equipment".

12.8.6 The pipeline supplying fuel oil to diesel generators is to be separated from other fuel oil supply pipelines and be fitted with its own filters and shut-off fittings.

12.8.7 The fuel oil system is to be equipped with measuring instruments according to 2.12, Part VIII "Machinery". Sight glasses on pipelines are to be heat-resistant.

12.8.8 Fuel oil system components and connections within fuel supply lines are to be designed considering the maximum peak pressure to be experienced in service, including any high pressure pulses and hydraulic impacts which are generated and transmitted back into fuel supply and spill lines by the action of fuel injection pumps.

12.9 FUEL OIL SUPPLY TO BOILERS

12.9.1 The pumps supplying fuel oil to boilers are not to be used for other purposes.

12.9.2 The pipelines conveying fuel oil to the burners of each boiler are to be fitted with quick-closing valve with local manual operation.

This requirement is applicable to boilers with manual igniters and also to boilers with gravity supply of fuel oil to the burners.

Where an automated auxiliary boiler is installed, no quick-closing valve is required.

12.9.3 Where fuel oil is supplied to the burners by gravity, filters are to be fitted in the supply pipeline to the burners.

12.9.4 Oil burning installation of the boilers is to comply with the requirements of Section 5, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships.

12.9.5 Thermometers and pressure gauges are to be installed in appropriate places on the pipes supplying fuel oil to the burners.

12.10 USE OF CRUDE OIL OR SLOPS AS FUEL FOR BOILERS ON OIL TANKERS

12.10.1 On oil tankers, crude oil or slops may be used as fuel for main and auxiliary boilers according to the requirements of the present Chapter.

For this purpose, all arrangement drawings of the installation with pipeline layout and safety equipment are to be submitted to the Register for approval.

12.10.2 Crude oil or slops are to be taken directly from cargo tanks and special slop tanks installed in the cargo tank area. They are to be separated from non-gas-dangerous areas by means of cofferdams with gastight bulkheads.

12.10.3 The construction of boilers and burners is to be proved to be satisfactory in operation with crude oil.

The outer casing of the boilers is to be gastight separated from the engine room.

The boilers themselves are to be tested for gastightness before being used.

The whole system of pumps, filters, separators and heaters, if any, is to be fitted in the cargo pump room or in another room, to be considered dangerous and separated from engine and boiler room by gastight bulkheads.

Where crude oil is heated by steam or hot water, the outlets of the heating coils are to be laid to a separate observation tank installed together with the above-mentioned equipment.

This observation tank is to be fitted with an air pipe carried to a safe place on the open deck according to the requirements of 9.2.4.1 for oil tankers. The air pipe outlet is to be fitted with easily removable flame arresters.

12.10.4 The arrangement of prime movers of pumps, separators, etc. is to comply with the requirements of 4.2.5, Part VI "Machinery Installations".

12.10.5 The pumps are to be fitted with a pressure relief bypass from delivery to suction side. It is to be possible to stop them by remote control placed in position near the boiler fronts or machinery control room and from outside the engine room.

12.10.6 When it is necessary to heat crude oil or slops, their temperature is to be automatically controlled and a high temperature alarm is to be fitted.

12.10.7 The pipeline for crude oil or slops and draining pipes from the tray specified in 12.10.9 are to have wall thickness in compliance with column 4 of Table 2.3.8.

The number of connections for these pipes is to be minimum.

Pipe connections are to be of flange type and are to comply with the requirements of Table 2.4.3.3 for pipelines of Class I.

Within the engine room and boiler room these pipelines are to be laid, along their full length, within metal duct which is to be gastight and tightly connected to the fore bulkhead separating the pump room and then to the above-mentioned tray.

This duct with the enclosed pipeline is to be at an inclination rising towards the boiler so that the fuel oil naturally returns towards the pump room in case of leakage or failure in delivery pressure.

Besides, the duct is to be fitted at a distance from the ship's inner side plate of at least 20 per cent of the ship's beam amidships.

The duct is to be fitted with inspection openings with gastight doors in way of pipe connections within it, with an automatically closing drain-trap placed in the pump room, arranged in such a way as to discharge leakage of crude oil into the pump room.

In order to detect leakages, level position indicators with relevant alarms are to be fitted on the drainage tank specified in 12.10.2.

Also an air pipe is to be fitted at the highest part of the duct and is to be laid to a safe place on the open deck according to the requirements of 9.2.4.1 for oil tankers. The outlet is to be fitted with easily removable flame arresters.

The duct is to be permanently connected to the inert gas system or steam supply in order to provide:

injection of inert gas or steam in case of fire or leakage;

purging of the duct before carrying out work in case of leakage.

12.10.8 In way of bulkhead to which the duct defined in 12.10.7 is connected, delivery and return oil pipeliness are to be fitted on the pump room side with shut-off valves remotely controlled from a position near the boiler fronts or from the main machinery control room.

The remotely controlled valves are to be interlocked with the hood exhaust fans mentioned in 12.10.10 to ensure that whenever crude oil is circulating the fans are running.

12.10.9 Boilers are to be fitted with a tray or gutterway of a height not less than 200 mm and be placed in such a way as to collect any possible fuel oil leakage from burners, valves and connections.

Such a tray or gutterway at their upper part are to be fitted with easily dismountable flame arresters.

Delivery and return fuel oil pipes are to pass through the tray or gutterway by means of tight penetration and are then to be connected to fuel oil supply manifolds.

A quick-closing master valve is to be fitted on the fuel oil pipeline to each manifold.

The tray or gutterway are to be fitted with a draining pipe discharging into a collecting tank in pump room. This tank is to be fitted with an air pipe laid to a safe place on the open deck. The outlet of the air pipe is to be fitted with easily dismountable flame arresters.

The above-mentioned drain pipe is to be fitted with arrangements to prevent the return of gas to the boiler or machinery space.

12.10.10 The boilers are to be fitted with a suitable hood placed in such a way as to enclose as much as possible burners, valves and fuel oil pipes, without interfering, on the other side, with air inlet to burner register.

The hood, if necessary, is to have means of inspection and access to fuel oil pipes and valves placed behind them.

The hood is to be fitted with a duct laid to a safe place on the open deck and fitted with easily dismountable flame arresters.

At least two mechanically driven exhaust fans having spark proof impellers are to be fitted so that the pressure inside the hood is less than that in the boiler room.

The exhaust fans are to be connected with automatic change-over device providing starting of another fan in case of stoppage or failure of the fan in operation.

The exhaust fan prime movers are to be placed outside the duct and a gastight sealing is to be arranged for shafts.

Electrical equipment installed in gas hazardous areas or in areas which may become hazardous (i.e. in the hood or duct in which crude oil pipelines are placed) is to be of certified safe type as required by the appropriate authority.

12.10.11 Provision is to be made for fuel oil delivery to, and return from, the boilers, in connection with which equipment complying with the requirements of 12.9 of the present Part and Section 5, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships are to be fitted in the boiler room.

Fuel oil delivery to, and return from, burners are to be effected by means of suitable mechanical interlocking device so that running on fuel oil automatically excludes running on crude oil or vice versa.

12.10.12 The boiler compartments are to be fitted with mechanical ventilation installation designed in such a way as to avoid formation of gas pockets. Ventilation is to be particularly efficient in way of electrical equipment, machinery and other plants which may generate sparks. These ventilation is to be separated from ventilation for other compartments and is to comply with the requirements of Section 11.

12.10.13 A gas detector device is to be fitted with intakes in the duct mentioned in 12.10.7, in the hood duct, downstream of exhaust fans in way of boilers, and in all zones where the ventilation efficiency may be reduced.

Light warning devices are to be provided near the boiler fronts and in the main machinery control room. A sound alarm in the engine room and the main machinery control room, is to be provided.

12.10.14 Means are to be provided for the boiler to be automatically purged before firing.

12.10.15 Independent of the fixed fire extinguishing system required for the machinery spaces in accordance with the Rules, additional fire extinguishing installation is to be fitted is such a way that it is possible for an approved fire extinguishing medium to be directed on to the boiler fronts and on to the tray defined in 12.10.9.

The release of extinguishing medium is to automatically stop the exhaust fan of the boiler hood (refer also to 12.10.8).

12.10.16 A notice is to be fitted in a clearly visible place near the boiler front. This notice is to specify that when an explosive mixture is signalled by the gas detector plant defined in 12.10.13, the attending persons are to immediately shut off the remote controlled valves on the crude oil delivery and return pipelines in the pump room, stop the relevant pumps, inject inert gas into the duct mentioned in 12.10.7 and turn the boilers to normal running on fuel oil.

12.10.17 The Register reserves the right to require installation of a pilot burner in addition to the normal burning control.

12.11 APPLICATION OF NATURAL GAS AS FUEL FOR DUAL-FUEL INTERNAL COMBUSTION ENGINES

12.11.1 Gas fuel pipelines are not to be laid through control stations, accommodation and service spaces. Laying of gas fuel pipelines through other spaces is allowed subject to compliance with the requirements of 12.11.2 or 12.11.3.

12.11.2 The pipeline represents a pipeline system with double walls containing gas fuel inside the internal pipe. The following conditions are to be met:

.1 the space between the walls is to be filled with inert gas under pressure exceeding gas fuel pressure;

.2 inert gas pressure is to be constantly indicated by an alarm system;

.3 at the alarm system actuation the automatic valves mentioned in 12.11.5 and the main gas valve referred to in 12.11.6 are to be automatically closed before the inert gas pressure drops lower than the pressure of gas fuel, and the vent valve indicated in 12.11.5 is to be automatically opened;

.4 the system is to be arranged so that the internal part of the gas fuel supply pipeline between the main gas valve and engine be automatically purged with inert gas, when the main gas valve is closed.

12.11.3 Gas fuel pipelines are to be installed in a pipe or duct with artificial exhaust ventilation of the space between them. The capacity of exhaust ventilation is to be determined basing on the velocity of gas fuel flow, structure and location of protective pipes or ducts and provide at least 30 air changes per hour.

Therewith, the following conditions are to be met:

.1 the pressure in the space between the external and internal walls of pipelines or ducts is to be kept lower than the atmospheric pressure;

.2 provision is to be made for the gas leakage detector and the cut-off of the gas supply to the machinery space;

.3 electric motors are to be of safe design and be located outside pipes and ducts;

.4 when the required air flow is not maintained by the ventilation system, the main gas valve indicated in 12.11.6 is to be automatically closed. Ventilation is to function every time when gas is supplied through the pipeline;

.5 air intakes of the ventilation system are to be provided with non-return devices. These requirements are not compulsory when gas detectors are fitted in air intakes;

.6 provision is to be made for inertization and gas-freeing of the gas fuel system section located in the machinery space.

12.11.4 For machinery spaces of category A where gas fuel is used, besides the requirements of 12.11.2 or 12.11.3, the additional requirements to ventilation are to be met:

.1 machinery spaces are to be fitted with ventilation system precluding gas pockets. Ventilation is to be particularly effective in the area where electrical equipment, machinery or other sources of spark formation are installed. Ventilation system is to be separated from ventilation of other spaces;

.2 machinery spaces are to be equipped with an effective gas detection system in the places of possible gas accumulation and leakage. When the concentration of gas is equal to 30 per cent of low flammability limit, the audible and visual alarms are to be actuated, and when the concentration of gas is equal to 60 per cent of low flammability limit, the supply of gas fuel to the machinery space is to be cut off.

12.11.5 Gas fuel supply system is to be fitted with three automatic valves. Two of them are to be placed in series in the system of gas supply to the engine. The third valve (ventilation) is to be mounted to withdraw gas from the pipe section located between two automatic valves placed in series to a safe place on the open deck. The system is to be constructed so that when the pressure in the gas supply pipeline deviates from the set values, power is lost for valve actuation, conditions stated in 12.11.2 and 12.11.3 are violated, the engine is shut down because of any reason two valves placed in series are to be closed automatically and the third valve (ventilation) is to be opened automatically. As an alternative, one of two valves placed in series and the ventilation valve may be combined in a common body, provided they perform the above-mentioned functions. All three valves are to be arranged for manual operation.

12.11.6 The main gas valve is to be installed outside the machinery space and be equipped with remote control to enable it being closed from the machinery space. This valve is to be automatically closed in the following cases:

leakage of gas fuel;

violation of the conditions stated in 12.11.2 and 12.11.3;

actuation of oil mist concentration sensor in the engine crankcase or of the temperature control system of the engine bearings.

It is recommended, that the main gas valve is automatically closed at the actuation of interlocked gas valves (refer to Table 3.7.1, Part VIII "Machinery").

12.11.7 Gas pipelines are to have sufficient structural strength with regard to stresses induced by the weight of the pipeline, internal pressure, loads caused by the ship's hull bending and accelerations.

12.11.8 The structure of protective pipes or ventilation ducts mentioned in 12.11.2 and 12.11.3 is to have strength sufficient to withstand fast increase of pressure in case of pipe break. The number of detachable connections in protective pipes or ducts is to be minimum.

12.11.9 As a rule, gas pipelines are to be connected by complete-penetration butt welds and special means are to be provided to ensure weld root quality . The welded joints are to be completely radiographically tested.

All butt welds after welding are to be subjected to heat treatment depending on the material.

The use of other joints is subject to special consideration by the Register in each case.

12.11.10 The installation for gas fuel supply and reservoirs for gas fuel storage are to comply with the following requirements:

.1 the construction, control and safety system of gas compressors, pressure vessels and heat exchangers incorporated in the gas fuel supply system, are to meet the requirements of the appropriate Parts of the Rules;

.2 during design and calculations the possibility of fatigue failure of gas pipelines because of vibration as well as fluctuation of pressure when the gas fuel is supplied by compressors is to be considered.

12.11.11 Gas supply to dual-fuel engines is to meet the requirements of Section 3, Part VIII "Machinery".

13 LUBRICATING OIL SYSTEM

13.1 LUBRICATING OIL PUMPS OF INTERNAL COMBUSTION ENGINES, GEARS AND COUPLINGS

13.1.1 For an installation with one main engine provision is to be made for not less than two lubricating oil pumps, main and standby, of the same capacity. One of these pumps may be driven by the main engine.

13.1.2 Where two or more main engines are installed, each of them is to have its own lubricating oil pump.

A common lubricating system of the main engines is subject to special consideration by the Register in each case.

13.1.3 On cargo ships of less than 500 gross tonnage, standby pumps may not be installed irrespective of the number of main engines.

This exception does not apply to the following ships:

tugs with one main engine;

passenger ships with one main engine.

13.1.4 In installations having automation marks in their class notation, provision is to be made for separate standby lubricating oil pumps the capacity of which is to be not less than that of the main pumps.

13.1.5 Where the turbo-blowers of the main engines have an independent electrically driven lubricating oil pump, provision is to be made for a standby pump of the same capacity and a gravity tank containing sufficient oil to maintain lubrication of turbo-blowers during idle rotation if the oil pump suddenly stops working.

Warning alarms are to operate when the oil level in the tank drops below the permissible one and automatic starting of the standby pump is to be ensured at stoppage of the pump at work.

Means are to be provided to enable the oil flow in turbo-blower bearings to be monitored.

13.1.6 Lubricating oil pumps of the main gearing, as well as pumps filling the main fluid couplings are to comply with the requirements of 13.1.1 to 13.1.4 for the main engines.

13.1.7 Each auxiliary engine and each emergency diesel generator engine (refer to 2.2.4, Part VIII "Machinery") is to have a separate lubricating system.

A common lubricating system of auxiliary engines is, in each case, subject to special consideration by the Register.

13.1.8 If the lubricating oil pump is not fitted with a relief or bypass valve, such valve is to be installed on the pressure pipeline.

13.2 LUBRICATING OIL SUPPLY TO INTERNAL COMBUSTION ENGINES AND GEARS

13.2.1 The construction of the oil drain tank and the working level therein as well as the arrangement of the suction connections of pumps is to be such as to preclude failure of lubricating oil supply at the greatest possible for the ship's type concerned dynamic and static angles of heel and trim. No communication is allowed between lubricating oil drain pipes of two or more engines.

13.2.2 Pipelines of the lubricating oil system are not to communicate with other pipelines systems, except where they are connected to separators which may be used for fuel oil purification. In the latter case, efficient arrangements are to be provided to preclude mixing of fuel oil and lubricating oil as well as different grades of lubricating oil.

13.2.3 The lubrication system is to provide efficient cleaning of oil for which purpose filters are to be fitted as follows:

.1 magnetic filter generally on the suction side of the pump of gears;

.2 one coarse filter (strainer) on the suction side of the pump; two parallel filters or one switch-over duplex filter or a self-cleaning filter on the pressure side of the main engine pump.

13.2.4 The capacity of each oil filter is to exceed by 10 per cent the maximum capacity of the pump.

13.2.5 The lubricating oil system is to be fitted with instruments in accordance with Table 2.10.5, Part X "Automation".

The pressure gauge indicating the pressure after the oil cooler is to be placed at the control station.

13.2.6 The lubricating oil drain pipes from the engine crankcase are to terminate in the oil drain tank so as to be submerged in oil all the time of the engine operation.

13.3 LUBRICATING OIL TANKS

13.3.1 Lubricating oil tanks are to be separated from feed water and vegetable oil tanks by cofferdams the structural members of which are to comply with the requirements of Part II "Hull".

13.3.2 The suction pipes from the tanks situated outside the double bottom are to be fitted with shut-off valves installed directly on the tanks.

In tanks of a capacity of more than 500 l which, except for gravity lubrication systems, are open in normal conditions, such valves are to be remote-controlled from always accessible places outside the space containing the tank.

13.3.3 Arrangements for heating of lubricating oil are to comply with the requirements of 12.3.

13.3.4 For lubricating oil tanks arranged in machinery spaces of category A (refer to 1.2, Part VI "Machinery Installations") and, whenever practicable, in other machinery spaces, the requirements of 9.6, 12.5.1 of the present Part and of 4.3.3, 4.3.4, Part VI "Machinery Installations", are to be met, as far as lubricating oil tanks installed above heated surfaces of engines and machinery are concerned.

13.3.5 No lubricating oil tanks are to be located forward of the collision bulkhead.

13.4 ARRANGEMENTS FOR COLLECTION OF LUBRICATING OIL LEAKAGE

13.4.1 The requirements of 12.5 are applicable to the arrangements for collection of lubricating oil leakage in machinery spaces of category A.

14 COOLING WATER SYSTEM

14.1 PUMPS

14.1.1 The water cooling system of main and auxiliary engines is to be of two-circuit type. Provision is to be also made for direct cooling of the engine by sea water.

14.1.2 In each circuit, it is allowed to cool several engines by one independently driven pump. In this case, the capacity of the pump is to be sufficient for simultaneous cooling of all engines when running at maximum load. The cooling pipeline is to have a water control valve at inlet to each engine.

14.1.3 The ballast, bilge or other general service pumps operated only for clean water may be used as standby cooling pumps. The use of fire pumps for this purpose is allowed if the requirements of 4.3.2, Part V "Fire Protection" are met.

14.1.4 A reserve pump with a capacity not less than that of the main pump is to be provided in an independent sea water cooling and lubricating system for stern bearings. Any sea water general purpose pump may be used as a reserve pump.

14.2 PIPELINES LAYING

14.2.1 Sea water cooling system is to be supplied from at least two interconnected sea inlets. On cargo ships with one main engine of less than 220 kW power output, one sea inlet is allowed, in this case provision is to be made for two parallel-connected filters.

14.2.2 The requirements for heating of sea chests on ice-strengthened ships are given in 4.3.1.2.

14.3 COOLING WATER FILTERS

14.3.1 Filters are to be fitted on suction lines of sea water cooling system serving the main and auxiliary engines. Filters are to be provided with a device making it possible to be sure, before the filters are opened, that there is no pressure. Means are to be provided to enable the filters to be cleaned without stopping cooling pumps.

14.4 COOLING OF INTERNAL COMBUSTION ENGINES

14.4.1 In a two-circuit cooling system of the engine, provision is to be made for an expansion tank where the level of water is higher than the maximum level of water in the engine. The expansion tank is to be connected to the suction pipelines of the pumps and may be common for the cooling system of several engines.

The tank is to be provided with a water level indicator.

In the cooling system of engines, the arrangement of sea water discharge pipelines is to be such that the highest cooled spaces of engines, water coolers and oil coolers are always filled with water, and formation of stagnant pockets is excluded.

14.4.2 The cooling system is to be fitted with thermometers and cooling water temperature control devices. It is recommended that suitable alarms are to be provided to warn of the limit value of the cooling water temperature.

14.4.3 The engine cooling system of the to be used as an emergency engine is to comply with the requirements of 2.2.4, Part VIII "Machinery".

14.4.4 On ice-strengthened ships, it is recommended to provide arrangements for heating the engines prior to starting. Engines are to be heated by heated cooling water, steam is not to be used for this purpose.

14.5 KEEL COOLING SYSTEMS

14.5.1 Keel cooling systems of internal combustion engines are allowed subject to the following conditions:

.1 for ships equipped with one main engine, not less than two sea-water coolers, one of which is standby, are to be provided. The system is to be equipped with at least two pumps, one of which is standby;

.2 for ships equipped with two or more main engines the standby cooler and pump may be omitted;

.3 each cooler is to be provided with air discharge arrangement;

.4 on pipelines for supply and rejection of cooling medium to coolers check valves are to be provided in compliance with the requirements of 4.3.2;

.5 arrangements for discharge of cooling medium from the coolers are to be provided.

15 COMPRESSED AIR SYSTEM

15.1 NUMBER AND CAPACITY OF STARTING AIR RECEIVERS

15.1.1 The compressed air system of the main engines is to ensure simultaneous starting and reversing of all main engines and starting arrangements are to comply with the requirements of 2.9, Part VIII "Machinery".

15.1.2 The total amount of compressed air for the main engines starting and the associated pneumatic control systems is to be stored in not less than two air receivers or two groups of them so arranged that they may be used independently; the capacity of each air receiver, or each group of air receivers is to be at least 50 per cent of that required by 15.1.3 and 15.1.4 (refer also to 15.1.6).

15.1.3 The total capacity of air receivers for starting and reversing of the main engines is to be sufficient to provide not less than 12 starts alternating between "ahead" and "astern" of each engine in cold and ready to start condition, as well as the operation of engine control systems.

15.1.4 The total capacity of air receivers for starting of the main engines connected to a controllable pitch propeller or some other machinery, enabling to start without opposite torque, is to be sufficient to provide not less than 6 starts of each engine being in cold and ready to start condition, and where there are more than two engines, at least three starts of each engine. At the same time, the operation of engine control systems is to be provided.

15.1.5 For starting of the auxiliary engines provision is to be made for at least one air receiver with a capacity sufficient to provide 6 starts of the largest engine in cold and ready to start conditions.

On special agreement with the Register such air receiver may be omitted.

In this case it is to be possible to start auxiliary engines from one air receiver or one group of air receivers of the main engines.

15.1.6 It is allowed to use the starting air stored in one air receiver, or in a group of air receivers of the main engines according to 15.1.2, to feed the tyfon whistle, as well as for domestic needs, provided the capacity of the air receiver is increased by an amount of air specified below for a special air receiver of the tyfon, or where the air receiver is fitted with automatic replenishing devices or with alarms which give warning when the pressure in the air receiver drops by not more than 0,49 MPa below the working pressure.

Where an air receiver is fitted especially for tyfon, its capacity is to be determined so that the tyfon be able to work continuously for 2 min, with hourly performance of compressor being not less than required to provide continuous operation of tyfon during 8 min.

If air from the air receiver of the tyfon is consumed also for other purposes, its capacity is to be increased as compared with that designed for tyfon only, with provision being made for automatic replenishing or signalling means operating as soon as the amount of air in the air receiver is such as required for tyfon only.

15.1.7 The air receivers of auxiliary engines indicated in 15.1.5 may be replenished from air receivers of the main engines specified in 15.1.6, with any possibility of back flow being excluded.

15.1.8 Starting devices of the emergency diesel generator are to comply with the requirements of 9.5.2, Part IX "Electrical Equipment".

Where a compressed air system is used as one of the means of starting the emergency diesel generator, the air receiver may be filled from main and auxiliary starting air receivers through a non-return valve fitted in the emergency generator room, or from an electric compressor supplied from the emergency switchboard.

15.1.9 Air receivers are to be equipped with a dehumidifier.

15.2 COMPRESSORS

15.2.1 The number of the main air compressors is to be at least two. The total capacity of the main compressors is to be sufficient for the filling of the main air receivers during one hour for starting the main engines, beginning from the atmospheric pressure to the pressure required to carry out the number of starts and manoeuvres referred to in 15.1.3 and 15.1.4. One of the main compressors may be attached to the engine. The capacity of individual main compressors is to be approximately the same. The capacity of the independently driven compressors is to be not less than 50 per cent of that required of all the main compressors, but not less than the air consumption for the tyfon according to 15.1.6.

15.2.2 On high-speed craft with reversible main engines, one independently driven compressor is allowed, whereas with main engines of non-reversible type, one attached compressor is allowed, if provision is made for the air receivers to be filled by shore-based facilities. The capacity of the compressors is to be in compliance with the requirements of 15.2.1.

15.2.3 On ships with the main and auxiliary engines arranged for compressed air starting, provision is to be made for the possibility of starting the main compressors during not more than one hour. For this purpose it is allowed to use a hand compressor or a manually operated diesel-generator to fill a separate air receiver which capacity is sufficient for three starts of one of the diesel generators or one of the main compressors where it is driven by an internal combustion engine.

A separate air receiver may be omitted where the diesel compressor or hand compressor is capable of filling the smallest of the air receivers specified in 15.1.5 during the aforesaid time period.

Where the motor of the compressor supplying one of the air receivers considered in this paragraph can be supplied from the emergency diesel generator, the above-mentioned device is not necessary.

This requirement is not applicable to cargo ships of less than 500 gross tonnage.

15.3 PIPELINES LAYING

15.3.1 All pressure pipelines from starting air compressors are to be laid directly to starting air receivers, and all starting air pipelines from air receivers to main or auxiliary engines are to be separated from the compressor pressure pipelines.

15.3.2 Each of the starting air receivers specified in 15.1 is to be capable of being filled from each main compressor specified in 15.2. The possibility of back flow is to be precluded (refer to 15.1.7).

15.3.3 Non-return shut-off valves are to be installed on the discharge pipeline of each compressor.

The manifold supplying starting air to each engine is to have a non-return valve placed before the starting valve of the engine.

The non-return valve may be omitted, if provision is made in the engine design for suitable arrangements protecting the manifold from the effects of internal explosion (refer to 2.9.1 and 2.9.2, Part VIII "Machinery").

15.3.4 The temperature of air or compressed gas entering the receivers is not to exceed 90°C. Where required, provision is to be made for appropriate coolers.

The compressed gas pipelines from gas bleeding devices are not to be laid under the engine room floor plating.

15.3.5 The pipelines are to be laid as straight as practicable with a slope for water drainage.

The pipelines are not to have a slope in the direction of the master starting valve of the engine.

15.3.6 Arrangements for draining oil and water are to be provided on the pipelines between compressors and air receivers, unless drain arrangements are fitted on the compressors.

15.3.7 If the pressure relief valves and fuse plugs fitted on air receivers are arranged to discharge compressed air outside the engine room, the sectional area of discharge pipelines is to be not less than a two-fold section of pressure relief valves or fuse plugs; appropriate arrangements for draining water from the pipelines are to be provided.

15.3.8 The pneumatic sound devices of the emergency alarm system stipulated by 7.3, Part IX "Electrical Equipment" are to be connected to starting air receivers by means of separate pipelines.

16 FEED WATER SYSTEM

16.1 PUMPS

16.1.1 Each main boiler and essential auxiliary boiler or a group of boilers are to be provided with at least two independent power driven feed pumps.

For non-essential auxiliary boilers, as well for exhaust gas boilers so constructed that they can be left without water when heated by exhaust gas, one feed pump is sufficient.

For boilers with manual feed control the capacity of each pump is to be not less than 1,5 times the rated capacity of the boilers, and for boilers with automatic feed control, not less than 1,15 times their rated capacity.

Where more than two feed pumps are installed, their capacity is to be such that in case of any of the pumps failure the total capacity of the rest of the pumps is not less than the capacity required above for one pump.

The capacity of each feed pump of a straight-through boiler is to be not less than the rated capacity of the boiler.

16.1.2 In case of steam driven feed pumps, live steam is to be supplied to a separate line having connections from all the boilers fed by these pumps.

16.1.3 Main and essential auxiliary boilers with forced circulation are to be fed by not less than two circulating pumps, one of which is a standby pump.

16.2 PIPELINES LAYING

16.2.1 In case of open circuit feed system, feed pumps are to be provided with suctions from the hot well and from feed water storage tanks.

16.2.2 The feed system of each main boiler and each auxiliary boiler for essential services is to be so constructed as to provide a boiler or a group of boilers feeding by each feed pump through two separate feeding pipelines, i.e. the main and auxiliary lines.

For non-essential auxiliary boilers, one feeding pipeline is sufficient.

16.2.3 Structural measures are to be taken to prevent feed water being contaminated by oil and petroleum products.

16.3 TANKS

16.3.1 Feed water tanks are to be separated from tanks containing fuel oil, lubricating oil and vegetable oil by cofferdams the structural members of which are to comply with the requirements of Part II "Hull".

17 STEAM AND BLOW-OFF SYSTEMS

17.1 PIPELINES LAYING

17.1.1 Where two or more boilers are connected to a common steam line, a non-return valve is to be fitted on the steam line of each boiler before connection to the common line.

These valves may be omitted if stop valves of the boilers are of non-return shut-off type.

17.1.2 The blow-down and the scum valves of two or more boilers may be connected to a common discharge line, provided a non-return shut-off valve is fitted on the blow-off line of each boiler before connection to the common discharge line.

17.1.3 The machinery connected with steam lines is to be relieved of the stresses caused by thermal expansion of lines. This may be achieved by means of self-compensation (pipe bends) or by installation of thermal compensators in appropriate places.

17.1.4 In the steam lines delivering steam to the machinery and arrangements designed for a lesser pressure than the boiler pressure, reducing valves are to be fitted, and the requirements of 1.4.3 are to be complied with.

17.1.5 If a steaming system for fuel oil and liquid cargo tanks is provided, each tank is to be fitted with a non-return shut-off valve and the main line is to be provided with a shut-off valve placed in a readily accessible place outside the tanks.

17.1.6 The steam lines in the engine and boiler rooms are to be laid in the upper parts of these spaces, where practicable, in places accessible for observation and maintenance.

Installation of steam lines under the floor plates of engine and boiler rooms, except for heating pipelines and boiler blow-off lines, is not allowed.

Steam lines are not to be laid near fuel oil tanks.

Steam lines with working steam temperature above 220 °C are not allowed to be laid in cargo pump rooms of oil tankers.

17.1.7 When laying steam lines, the following minimum distance is to be maintained between pipelines insulation and:

hull structures – 50 mm;

cable routes – 150 mm;

fuel oil tanks – 450 mm;

electrical equipment – 500 mm.

The requirement of 5.5 is to be met.

17.2 BLOW-OFF ARRANGEMENTS OF STEAM LINES

17.2.1 Pipelines conveying live steam are to have steam traps to protect the machinery against water hammer.

17.2.2 Open ends of the pipes for steam line blow-off are to be carried below the floor plates of the engine and boiler rooms (refer also to 5.3.8).

18 THERMAL LIQUID SYSTEMS

18.1 DEFINITIONS AND EXPLANATIONS

18.1.1 Thermal liquid boiler is a heat exchanger intended to heat the thermal liquid to the required temperature through utilization of the power of fuel oil burnt therein, as well as exhaust gases or electric power.

Thermal liquid heater is a heat exchanger intended to heat the thermal liquid by steam, water or thermal liquid of another circuit.

Working pressure in a thermal liquid system is the highest pressure possible in operation of the system in any part thereof.

Thermal liquid system is a system wherein the thermal liquid circulates in liquid phase.

Thermal liquid temperature is a temperature measured at the centre of the pipeline cross-section.

18.2 REQUIREMENTS FOR THERMAL LIQUID

18.2.1 Therma liquid may be used within the range of working temperatures established by the manufacturer. The maximum working temperature of thermal liquid is to be by at least 50 °C below the temperature at which the boiling begins under atmospheric pressure.

18.2.2 In thermal liquid heaters, the temperature of the heating medium is to be below the temperature at which the heated thermal liquid begins to boil.

18.3 PUMPS

18.3.1 For the circulation of thermal liquid, a pump is to be provided in the system. In the circulation circuits of boilers as well as essential consumers, provision is to be made for redundancy of circulating pumps.

18.3.2 On the outlet side of thermal liquid, pressure gauges are to be fitted.

18.3.3 Thermal liquid circulating pumps are to be fitted with disconnectors complying with the requirements of 5.7.1, Part IX "Electrical Equipment".

18.4 EXPANSION TANK

18.4.1 Systems containing thermal liquids are to include an expansion tank located highest in the system.

18.4.2 The expansion tank is to be equipped with a level indicator in accordance with 9.6.

On the level indicator, the lowest permissible level of liquid is to be marked.

18.4.3 In the open system, the expansion tank is to be equipped with an air pipe and also with an overflow pipe laid to a bilge tank, and where no bilge tank is provided, to a storage tank.

18.4.4 Provision is to be made for signals to be activated when the lowest or the highest level of liquid is reached in the tank. When the level of liquid drops below the permissible level, the heating of thermal liquid in boilers is to be stopped automatically and the circulating pumps are to be shut down.

18.4.5 In closed systems, the expansion tank is to be equipped with a pressure gauge and a safety valve. The outlet pipe of the safety valve is to be connected with the bilge tank or storage tank.

Provision is to be made for the closed system to operate in the open system mode.

18.4.6 The expansion tanks having thermal insulation are to be equipped with thermometers to monitor the temperature of thermal liquid.

18.4.7 The capacity of the expansion tank within sight of the level indicator, measured from the mark of the lowest permissible level up to the lower edge of the overflow pipe, is to be sufficient to take into account the increase in the thermal liquid amount throughout the system due to its temperature variations in operation.

18.4.8 The expansion tank is to be equipped with a valve for emergency discharge of thermal liquid, operated both locally and remotely outside the space where the tank is installed.

18.5 STORAGE TANK AND DRAIN TANK

18.5.1 The system is to be provided with a storage tank and drain tank.

The storage tank capacity is to be at least 40 per cent of the system capacity. Depending on the system purpose and the area of the ship's navigation, lesser storage tank capacity is allowed.

18.5.2 The drain tank capacity is to be sufficient for the discharge of the thermal liquid from the largest section of the system being disconnected. For the emergency discharge of the thermal liquid from boilers (refer to 3.5.5, Part X "Boilers, Heat Exchangers and Pressure Vessels" of Rules for the Classification and Construction of Sea-Going Ships), the tank capacity is to be sufficient for discharge thereinto of the thermal liquid from the whole system.

18.5.3 A common tank used for the storage of the thermal liquid and for discharge thereof from the system may be allowed. Where thermal liquid is discharged into such tank, the capacity of the latter is to be sufficient for the discharge of thermal liquid from the system having regard for the storage thereof. In this case, the location of the tank is to be such as to facilitate the discharge of the whole amount of thermal liquid from the system.

18.6 PIPELINES AND FITTINGS

18.6.1 Thermal liquid pipelines are to be laid in compliance with the requirements of Section 5 and 12.2.

18.6.2 Fittings having bellows seals are to be used in the system. The use of the fittings of gasket type is subject to special consideration by the Register.

18.6.3 Copper and copper alloys are not allowed to be used in the system components which are in contact with the thermal liquid.

18.6.4 Sealing joints and gaskets are to be made of materials resistant to thermal liquids.

18.6.5 No threaded connections are allowed for thermal liquid pipelines.

18.6.6 The steel pipe wall thickness is to comply with the requirements of 2.3.1. The design pressure is to be taken not less than 1,4 MPa.

18.6.7 The thermal liquid installation concept is to provide filling of the system, replenishment of the expansion tank and transfer of the thermal liquid.

18.6.8 In each independent circulation circuit, provision is to be made for sampling the thermal liquid.

18.6.9 The system is to be so designed as to prevent deterioration of the thermal liquid due to local overheating or contact with air.

18.6.10 An effective arrangement is to be provided in the system for trapping and rejection of issuing vapours and gases. Operation of this arrangement is not to result in circulation and heating of the thermal liquid in the expansion tank above 50 °C.

18.6.11 Provision is to be made in the system for a local manual control of at least the thermal liquid flow rate and temperature.

18.6.12 A nameplate bearing the following information is to be provided in a conspicuous place in the immediate vicinity of circulating pumps:

manufacturer;

year of installation;

maximum design working temperature of thermal liquid;

system capacity;

maximum permissible working pressure.

18.7 AIR PIPES

18.7.1 Air pipes of tanks containing thermal liquids are to comply with the requirements of 9.1.

18.8 ARRANGEMENTS FOR COLLECTING THERMAL LIQUID LEAKAGES

18.8.1 Arrangements for collecting thermal liquid leakages are to comply with 12.5.

18.8.2 Exhaust-heat boilers or gas outlet pipelines before them are to be fitted with arrangements precluding the penetration of the thermal liquid into the engine in case of leakage as well as water used for fire extinguishing or washing of the boiler on the gas side.

18.9 THERMAL LIQUID BOILERS

18.9.1 Thermal liquid boilers and heaters are to comply with the requirements of 3.5, Part X "Boilers, Heat Exchangers and Pressure Vessels" for the Classification and Construction of Sea-Going Ships.

18.10 INSULATION

18.10.1 The insulation of pipelines and equipment of the system are to comply with the requirements of 4.6, Part VI "Machinery Installations".

18.11 HEATING OF LIQUID CARGOES

18.11.1 Where the thermal liquid is used for heating of liquid cargoes or other liquid products, the heated thermal liquid is to be compatible with the products being heated when it comes into contact with them due to leakage in the heating coils or tubes. A thermal liquid which can enter into a dangerous reaction with the product being heated is not allowed for use.

18.11.2 Thermal liquid systems may be allowed for heating liquid cargos having a flash point below 60 °C only where provision is made for an independent intermediate system installed in the cargo zone. However, the independent intermediate system may be omitted if the following conditions are met:

the system is so arranged that a positive pressure in the coils is to be by at least 0,03 MPa above the static head of the cargo when the circulating pump is not in operation;

means are to be provided in the thermal liquid expansion tank for detection of flammable cargo vapours;

valves for individual heating coils are to be provided with locking devices to ensure that the coils are under the specified static pressure at all times.

18.12 THERMAL LIQUID SYSTEM PIPELINES TESTING

18.12.1 Thermal liquid system pipelines are to be tested in accordance with 20.2 in the same way as fuel oil pipelines.

19 DOMESTIC SERVICE SYSTEMS AND INSTALLATIONS

19.1 DOMESTIC LIQUEFIED GAS INSTALLATIONS

19.1.1 One distribution station is allowed to contain:

.1 one cylinder connected to the network; in this case, in order to connect a reducing valve placed on the cylinder head to the pipeline rubberized fabric hose with metal clamps to ensure tightness and security of coupling may be used;

.2 two cylinders, one of which is to be connected to the network and the other is used as a standby cylinder; both cylinders may be connected to the distribution network manifold; in this case a shut-off valve or cock is to be fitted between each cylinder and manifold and the station is to be provided with a notice prohibiting simultaneous use of both cylinders;

.3 two groups of cylinders, each consisting of two or three cylinders; in this case, one group of cylinders is to be connected to the distribution network manifold via red copper tubes, provided the requirements of 19.1.1.2 are met, while the other group is considered a standby; provision is to be made for only one reducing valve fitted on the manifold;

.4 the cylinders installed on board the ship are to bear brands of competent authorities as well as information on the date of hydraulic tests by pressure and on the kind of gas contained.

19.1.2 Liquefied gas pipelines and fittings.

19.1.2.1 Liquefied gas pipelines are to consist of seamless steel or copper pipes with inside diameter not less than 6 mm.

19.1.2.2 The pipelines wall thickness is to comply with the requirements of columns 2 or 8 of Table 2.3.8, Part VII "Systems and Piping".

19.1.2.3 Pipelines joints are to be welded. Threaded and flanged joints are to be allowed only at the connections of instruments, gas consumers and fittings.

19.1.2.4 Inside the distribution station, a shut-off valve or cock operable from a position outside the space is to be installed on the pipeline, near its way out from the station. If such arrangement is impracticable, the second shut-off valve or cock is to be installed outside the station where the pipeline leaves the station.

19.1.2.5 The pipelines from the distribution station to direct gas consumers are to be laid on the open deck and protected against mechanical damage.

The liquefied gas pipelines are not to pass through accommodation, service and machinery spaces.

19.1.2.6 Where several gas consumers are available on board the ship, each branch line from the common pipeline to the consumer is to be provided with shut-off fittings.

19.1.2.7 Reducing valves fitted in the system are to ensure effective pressure of gas delivered to the consumers not higher than 0,005 MPa.

Where double-stage reducing valves are used the intermediate pressure is not to be higher than 0,25 MPa.

The reducing valve or the first stage of pressure reduction which is constituent of the double-stage reducing valves is to be fitted in the distribution station. The valve is to be fitted on the pipeline section between the cylinder and shut-off valve and attached to the station bulkheads.

19.1.2.8 Cocks on the pipeline are to be fitted in readily accessible places.

The cock plug is to be provided with an arresting device which allow it to rotate through 90° and with an indicator of "open" and "closed" positions.

19.1.2.9 All the fittings are to be made of bronze, brass or of another corrosion-resistant material.

19.1.3 Testing of the liquefied gas installation.

19.1.3.1 The liquefied gas pipelines from the cylinders up to the reducing valves are to be tested as follows:

in shop – by hydraulic pressure of 2,5 MPa;

on board the ship – by air at a pressure of 1,7 MPa.

The liquefied gas pipelines from the reducing valves up to gas consumers after installation on board the ship are to be tested for tightness by air with an excessive pressure of 0,02 MPa.

19.1.3.2 The whole liquefied gas installation, once mounted on board the ship, is be tested for tightness while the system is subjected to a normal working pressure. The test is to be carried out with the use of soap solution; no gas seepage is to be observed.

19.1.3.3 The normal operation of gas consumers, including the arrangement used to cut off gas supply to the consumer is to be checked.

19.2 AIR HEATING INSTALLATIONS

19.2.1 The air heating installation is an installation intended to heat air, wherein the air is heated while passing through the combustion chamber of the air heater.

19.2.2 The spaces containing air heaters are to be considered as machinery spaces of category A, the air to be heated is to be taken in from outside the machinery spaces. Air intakes of air heaters located on the open decks are to be protected from penetration of spray and precipitation.

19.2.3 Heat exchangers of air heater combustion chambers are to be tight and tested by a pressure not lower than 0,1 MPa.

19.2.4 Ventilation ducts for hot air and pipelines for carrying off combustion products are to be made of steel or of a material equal to steel in fire resistance. No shut-off fittings are to be installed on pipelines for carrying off combustion products.

19.2.5 Combustion air is to be supplied by an independent air blower. Before the burner of the air heater is alight, the furnace chamber is to be ventilated with the use of air blower during at least 5 s.

19.2.6 Pipelines for fuel oil supply to the air heaters are to comply with the requirements of Section 12. The possibility of fuel oil coming into contact with the hot air or outgoing gas pipelines is to be precluded.

19.2.7 Fuel oil supply to the air heater is to be cut off automatically in cases of:

flame-jet cut-off at a burner;

loss or low head of air flow to the furnace chamber;

temperature of the air heated exceeding the pre-determined limit;

electric power loss.

Upon operation of protective devices, the air heater is to be capable of being actuated only locally.

19.2.8 Provision is to be made for fuel oil supply, hot air blowers and combustion air supply shutting off from two pla-ces, one of which is to be located outside the machinery space.

20 TESTS

20.1 HYDRAULIC TESTS OF FITTINGS

20.1.1 The fittings intended to work under a design pressure of more than 0,1 MPa, are to be subjected to hydraulic tests by a pressure according to 1.3.1, Part VIII "Machinery".

20.1.2 The fittings intended to work under a design pressure of 0,1 MPa and less, as well as in vacuum conditions are to be tested by a pressure not less than 0,2 MPa.

20.1.3 Valves, cocks and other fittings for installation on the shell plating below the load line, on sea chests and ice boxes are to be tested by a hydraulic pressure not less than 0,3 MPa.

20.1.4 After assembly, the fittings are to be tested for leakage by a hydraulic pressure equal to the design pressure.

20.2 HYDRAULIC TESTS OF PIPELINES

20.2.1 All Class I and Class II pipelines, as well as steam, feed water, compressed air and fuel oil pipelines with design pressure over 0,35 MPa irrespective of their class, are to be subjected to hydraulic tests in the presence of a Surveyor to the Register after completion of manufacture and before insulating and coating, by a test pressure equal to:

$$p_{test} = 1{,}5p \qquad (20.2.1\text{-}1)$$

where p = design pressure (refer to 2.3.1), in MPa.

The test pressure, in MPa, for steel pipes intended for design temperatures over 300 °C is to be determined by the following formula, but it need not exceed $2p$:

$$p_{test} = 1{,}5\frac{\sigma_{100}}{\sigma_t}p \qquad (20.2.1\text{-}2)$$

where σ_{100} = permissible stress at 100 °C;
σ_t = permissible stress at design temperature.

If during hydraulic tests excessive stresses arise, the value of test pressure determined by the Formula (20.2.1-2) may be reduced to $1{,}5p$ on agreement with the Register.

In no case the stresses arising during hydraulic tests are to exceed 0,9 of the yield stress of the material at the temperature of testing.

20.2.2 Pressure testing of small bore pipes (less than 15 mm) of any class may be omitted at discretion of the Register, depending on the purpose of the pipes.

20.2.3 After assembly, all pipelines are to be tested for leakage under operating conditions in the presence of a surveyor to the Register, except for:

.1 heating coils in tanks and liquid or gas fuel pipelines which are to be tested by a pressure of $1{,}5p$, but not less than 0,4 MPa, and for pipelines containing fuel oil heated above 60 °C, not less than 2,1 MPa;

.2 liquefied gas pipelines are to be tested for leakage (by air, halogens, etc.) to a pressure chosen depending on the leakage detection method applied.

20.2.4 Where, for technical reasons, hydraulic tests of the whole pipeline cannot be carried out, proposals are to be submitted to the Register for testing of separate pipe lengths, in particular, the end joints.

20.2.5 In case where hydraulic tests of an assembled pipeline are carried out on board the ship, tightness and strength tests may be combined.

20.3 TESTING OF PLASTIC PIPES

20.3.1 Plastic pipes are to be tested taking into consideration the requirements of 6.8, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships, and where necessary, their fire resistance is to be confirmed and flame spread tested in accordance with 3.3.1 and 3.3.2.1 of the present Part.

20.3.2 The quality of joints is to be tested taking into consideration the requirements of 3.5.2, and piping as assembled on board is to be tested in accordance with the requirements of 3.8.

PART VIII. MACHINERY

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the following engines and machinery:

.1 main internal combustion engines;

.2 gears and couplings;

.3 engines driving electric generators or auxiliary and deck machinery, units in assembly;

.4 pumps included into the systems covered by Part V "Fire Protection" and Part VII "Systems and Piping", except for manually operated pumps;

.5 power driven air compressors;

.6 turbochargers of internal combustion engines;

.7 fans included into the systems covered by Part VII "Systems and Piping";

.8 steering gear;

.9 anchor machinery;

.10 towing winches;

.11 mooring and coupling machinery;

.12 hydraulic drives;

.13 centrifugal separators.

1.1.2 For the classification of machinery installations of inland navigation ships by the Register, the requirements of Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships apply, as far as applicable for inland navigation ships

1.2 SCOPE OF TECHNICAL SUPERVISION

1.2.1 Conditions specifying the procedure of the Register technical supervision during the manufacture of machinery and equipment, as well as the procedure of review and approval of technical documentation are given in General Regulations for the Classification and Other Activity and Part II "Technical Documentation" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.2.2 The Register carries out technical supervision during the manufacture of engines and machinery listed in 1.1.1.

1.2.3 Prior to the manufacture of machinery, the following documents are to be submitted to the Register for review:

.1 on internal combustion engines;

.1.1 engine particulars as per data sheet or specifications;

.1.2 general view plans with engine longitudinal and transverse sections;

.1.3 drawings of bedplate, columns, engine bed, crankcase, cylinder block and other parts, cast or welded, with welding details and instructions;

.1.4 drawings of crankshaft as an assembly and details;

.1.5 specification of main details materials with indication of test pressure values (where required);

.1.6 drawings of main pipelines and systems associated with engine:

starting air;

fuel oil;

lubricating oil;

cooling water;

control, governing and protection;

insulation and lining of the gas exhaust pipelines;

.1.7 drawings of high pressure fuel oil pipelines and their protection in case of damage;

.1.8 drawings of the crankcase safety valves and scavenging air manifold and their arrangement;

.1.9 strength calculations pertaining to machinery parts regulated by the Rules;

.1.10 test programs for prototype and production models of engines;

.1.11 engine operating and maintenance manual;

.2 on all other machinery regulated by the present Part, except for internal combustion engines;

.2.1 machinery particulars as per data sheet or specifications;

.2.2 general view plans with machinery longitudinal and transverse sections;

.2.3 drawings of bedplates, crankcases, engine beds, casings, covers and other parts, cast or welded, with welding details and instructions;

.2.4 drawings of crankshafts, thrust shafts, output and other shafts as well as their drives (gears);

.2.5 drawings of pinions, gear wheels and their shafts;

.2.6 drawings of driving and driven parts of hydraulic gears, disengaging and flexible couplings;

.2.7 drawings of high pressure fuel oil pipelines and their protection in case of damage;

.2.8 drawings of insulation and lining of gas exhaust pipelines associated with machinery;

.2.9 drawings of main pipelines and fuel oil, lubricating oil, cooling, gas exhaust, scavenging, air, control, governing, alarm, protection and other systems associated with machinery;

.2.10 drawings of machinery hydraulic pipelines with hydraulic drives;

.2.11 strength calculations of machinery parts regulated by the Rules;

.2.12 list of main parts of machinery with material specification and all details for test pressure values (where required);

.2.13 machinery operation and maintenance manual;

.2.14 test program for prototype and production models of machinery.

1.2.4 Drawings of machinery parts listed in Table 1.2.4 but not mentioned in 1.2.3 are subject to agreement with the Register.

Table 1.2.4

Nos	Item	Material	Chapter of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships
1	**Internal combustion engines**		
1.1	Bedplate, crankcase, frames, casing of thrust bearing built in the engine, main bearing caps of suspended crankshafts	Cast iron Cast steel Forged steel Rolled steel Aluminium alloy	3.9, 3.10 3.8 3.7 3.2 5.2
1.2	Cylinder block, cylinder covers, valve housings	Cast iro Cast steel Forged steel	3.9, 3.10 3.8 3.7
1.3	Cylinder liners and their parts	Cast iron Cast steel	3.9, 3.10 3.8
1.4	Piston	Cast iron Cast steel Forged steel Aluminium alloy	3.9, 3.10 3.8 3.7 5.2
1.5	Piston rod, crossheads, gudgeon pins	Forged steel	3.7
1.6	Connecting rod with crank bearing covers	Forged steel	3.7
1.7	Crankshaft, thrust shaft of built-in thrust bearing	Forged steel Cast steel Cast iron	3.7 3.8 3.9
1.8	Crankshaft detachable couplings	Forged steel Cast steel	3.7 3.8
1.9	Bolts and studs of crossheads, main and connecting rod bearings, cylinder covers	Forged steel	3.7
1.10	Tie rods	Forged steel	3.7
1.11	Inlet and outlet valves	Forged steel	3.7
1.12	Connecting bolts of crankshaft sections	Forged steel	3.7
1.13	Shaft and rotor of turbocharger, including blades	Forged steel	3.7
1.14	Camshaft, camshaft drive gears	Forged steel	3.7
1.15	Rotation speed governors and overspeed devices	-	-
1.16	Safety valves of the crankcase (for engines with a bore exceeding 200 mm)	-	-
1.17	Counterweights if not integral with the crankshaft	Forged steel Cast steel Cast iron	3.7 3.8 3.9
1.18	Main, connecting-rod, crosshead bearings	-	-
1.19	High-pressure fuel oil pumps	-	-
1.20	Nozzles	-	-
1.21	High-pressure oil fuel injection pipes	Rolled steel	3.4
2	**Gears, elastic and disengaging couplings**		
2.1	Casing	Forged steel Rolled steel Cast steel Cast iron Aluminium alloy	3.7 3.2 3.8 3.9, 3.10 5.2

Table 1.2.4 - continued

Nos	Item	Material	Chapter of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.
2.2	Shafts	Forged steel	3.7
2.3	Pinions, wheels, wheel rims	Forged steel Cast steel	3.7 3.8
2.4	Coupling components transmitting the torque: **.1** rigid components **.2** elastic components	 Rolled steel Forged steel Cast steel Cast iron Aluminium alloy Rubber, synthetic material Spring steel	 3.2 3.7 3.8 3.9 5.1, 5.2 - -
2.5	Coupling bolts	Forged steel	3.7
3 **3.1**	**Compressors and piston-type pumps** Crankshaft	 Forged steel Cast steel Cast iron	 3.7 3.8 3.9
3.2	Piston rod	Forged steel	3.7
3.3	Connecting rod	Forged steel Cast iron Aluminium alloy	3.7 3.9 5.2
3.4	Piston	Cast iron Cast steel Forged steel Aluminium alloy Copper alloy	3.9, 3.10 3.8 3.7 5.2 4.1
3.5	Cylinder block, cylinder covers	Cast iron Cast steel	3.9, 3.10 3.8
3.6	Cylinder liner	Cast iron	3.9, 3.10
4 **4.1**	**Centrifugal pumps, fans and air blowers** Shaft	 Rolled steel	 3.2
4.2	Impeller	Forged steel Cast steel Copper alloy Aluminium alloy	3.7 3.8 4.1 5.2
4.3	Casing	Cast iron Cast steel Rolled steel Copper alloy Aluminium alloy	3.9, 3.10 3.8 3.2 4.1 5.2
5 **5.1**	**Steering gear** Tiller of main and auxiliary gear	 Forged steel Cast steel	 3.7 3.8
5.2	Rudder quadrant	Cast steel	3.8
5.3	Rudder stock yoke	Forged steel	3.7
5.4	Pistons with rods	Forged steel	3.7
5.5	Cylinders	Cast iron	3.9, 3.10
5.6	Drive shaft	Forged steel	3.7
5.7	Pinions, gear wheels, tooth rims	Forged steel Cast steel Cast iron	3.7 3.8 3.9

Table 1.2.4 - continued

Nos	Item	Material	Chapter of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships
6 **6.1**	**Windlasses, mooring, coupling and towing winches** Drive, intermediate and output shafts	 Forged steel	 3.7
6.2	Pinions, gear wheels and tooth rims	Forged steel Cast steel Cast iron	3.9
6.3	Sprockets	Cast steel Cast iron	3.8 3.9, 3.10
6.4	Claw clutches	Forged steel Cast steel	3.7 3.8
6.5	Band brakes	Rolled steel	3.2
7 **7.1**	**Hydraulic drives, screw, gear and rotary pumps** Shaft, screw, rotor	 Forged steel Cast steel Copper alloy	 3.7 3.8 4.1
7.2	Piston rod	Forged steel Copper alloy	3.7 4.1
7.3	Piston	Forged steel Cast steel	3.7 3.8
7.4	Casing, cylinder and housing of screw pump	Cast steel Cast iron Copper alloy	3.8 3.9, 3.10 4.1
7.5	Pinions	Forged steel Cast steel Cast iron Copper alloy	3.7 3.8 3.9, 3.10 4.1
8 **8.1**	**Centrifugal fuel oil and lubricating oil separators** Bowl shaft	 Forged steel	 3.7
8.2	Bowl body, bowl discs	Forged steel	3.7
8.3	Drive pinions	Forged steel Copper alloy	3.7 4.1
Note. The materials are to be selected in accordance with the requirements of 1.6.			

In the process of manufacture all these parts are subject to the Register technical supervision regarding their compliance with the approved technical documentation and the requirements of Part XIII "Materials" and Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

1.2.5 Shafts of main gearing, pinions, gear wheels (tooth rims) are subject to ultrasonic testing during manufacture.

Steel parts of internal combustion engines are also subject to ultrasonic testing during manufacture in accordance with the requirements of Table 1.2.5.

Ultrasonic testing is to be carried out in accordance with the requirements of 2.2.9.2, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

1.2.6 For the internal combustion engines listed in Table 1.2.6 the steel cast and forged parts, their welded joints included, are to be tested during the manufacture for the absence of surface defects by the magnetic particles or by liquid penetrant method.

Table 1.2.5

Nos	Cylinder bore, in mm	Part No. according to Table 1.2.4
1	Up to and including 400	1.1, 1.2, 1.4, 1.6 and 1.7
2	More than 400	1.1, 1.2, 1.4 to 1.7

Table 1.2.6

Nos	Cylinder bore, in mm	Part No. according to Table 1.2.4
1	Up to and including 400	1.1, 1.5, 1.6
2	More than 400	All parts

1.2.7 If there are doubts about the absence of defects, the Register may require to carry out a non-destructive testing of other machinery parts and their welded joints.

1.3 HYDRAULIC TESTS

1.3.1 The machinery parts, except for internal combustion engine parts, operating under excessive pressure, after final machining and before protective coating is applied, are to be subjected to a hydraulic test by a test pressure determined by the following formula:

$$p_{test} = (1{,}5 + 0{,}1k)p \quad (1.3.1)$$

where p = maximum working pressure, in MPa;
k = factor according to Table 1.3.1.

In all cases the value of test pressure is not to be lower than the pressure set with the safety valve fully open, but not less than:

0,4 MPa for cooled spaces of parts and various seals;
0,2 MPa in other cases.

If temperatures or working pressure exceed the ratings indicated in Table 1.3.1, the value of test pressure is to be approved by the Register in each case.

1.3.2 The machinery parts and assemblies may be tested separately along the spaces by test pressure prescribed in compliance with the working pressure and the temperature inside each space.

1.3.3 Parts of internal combustion engines are to be tested according to the requirements specified in Table 1.3.3.

1.3.4 The machinery parts and assemblies filled with petroleum products or their vapours (reduction gear casings, sumps, etc.) under hydrostatic or atmospheric pressure are to be tested for oil-tightness by the method approved by the Register. Oil-tightness tests of welded structures may be confined to welded seams only.

Table 1.3.1

Material	Characteristic	Working temperature, in °C, up to									
		120	200	250	300	350	400	430	450	475	500
Carbon steel	p, in MPa	-	20	20	20	20	10	10	10	-	-
	k	-	0	1	3	5	8	11	17	-	-
Molybdenum and molybdenum-chrome steel with at least 0,4 per cent molybdenum content	p, in MPa	-	-	-	-	20	20	20	20	20	20
	k	0	0	0	0	0	1	2	3,5	6	11
Cast iron	p, in MPa	6	6	6	6	-	-	-	-	-	-
	k	0	2	3	4	-	-	-	-	-	-
Bronze, brass and copper	p, in MPa	20	3	3	-	-	-	-	-	-	-
	k	0	3,5	7	-	-	-	-	-	-	-

Table 1.3.3

Item	Test pressure [1]
Cylinder cover, cooling space[2] Cylinder liner over the whole length of the cooling space Piston crown, cooling space after assembly with the piston rod, if the latter forms a sealing	0,7 MPa
Cylinder block, cooling space Exhaust valve (body), cooling space Turbocharger, cooling space Exhaust pipeline, cooling space Coolers (on both sides)[3] Engine-driven pumps, lubricating oil, water, fuel oil booster, bilge – working spaces Engine-driven compressors including cylinders, covers and air coolers: water side	0,4 MPa, but not less than 1,5p
air side	1,5p
Casings of fuel oil injection pumps (pressure side), fuel oil valves and fuel oil pipes	1,5p or p+30 MPa, whichever is less
Scavenging pump cylinder	0,4 MPa
Hydraulic system pumps and pipeline, valve hydraulic drive cylinders	1,5p

[1] The above-stated norms may be changed for particular types of engines on agreement with the Register.
[2] In case of steel forged cylinder covers, hydraulic tests may be substituted by a survey using non-destructive test procedures and by submitting detailed data on thicknesses and dimensions.
[3] Air coolers of turbochargers are to be subjected to hydraulic test only on water side.

1.4 OPERATION TESTS

1.4.1 On completion of assembly, adjustment and running-in, prior to installation on board the ship, each item of machinery is to be bench tested under the load conditions according to test program approved by the Register.

In particular cases, bench tests may be substituted by tests on board the ship on agreement with the Register.

1.5 GENERAL TECHNICAL REQUIREMENTS

1.5.1 Machinery indicated in 1.1.1 is to remain operative under environmental conditions specified in 2.2, Part VI "Machinery Installations".

1.5.2 The design of the main machinery intended for installation on single-shaft ships is to provide, as a rule, a possibility of their operation in an emergency mode at reduced power in case of failure of parts, the replacement of which cannot be carried out on board the ship or demands much time.

1.5.3 Forged, cast and welded steel parts, as well as cast iron parts of the machinery are to be heat treated during manufacture in accordance with the requirements of 3.7.4, 3.8.4, 3.9.4, 3.10.4, Part XIII "Materials" and 2.1.16, Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

1.5.4 Fasteners used in moving parts of machinery and gears, as well as fasteners difficult for access are to be properly designed or to have special arrangements aimed at preventing their spontaneous loosening and releasing.

1.5.5 Heated surfaces of machinery and equipment are to be insulated according to the requirements of 4.6.1, Part VI "Machinery Installations".

1.5.6 The machinery parts which are in contact with a corrosive medium are to be made of anticorrosive material or to have corrosion-resistant coatings.

Sea water cooling spaces of machinery and coolers are to be provided with protectors.

1.5.7 Remote and automatic control systems, alarm and protection system included, are to comply with the requirements of Part XV "Automation" of Rules for the Classification and Construction of Sea-Going Ships.

1.5.8 Systems and piping of machinery are to comply with the requirements specified in Part VII "Systems and Piping".

1.5.9 Electrical equipment of engines and auxiliaries is to comply with the relevant requirements of Part IX "Electrical Equipment" of the Rules.

1.5.10 Power plant.

1.5.10.1 It is to be possible to start, stop or reverse the ship's propulsion reliably and quickly.

1.5.10.2 The following is to be monitored by suitable devices which trigger an alarm once a critical level has been reached:

.1 the temperature of the main-engine cooling water;

.2 the lubricating oil pressure for the main engines and transmissions;

.3 the oil and air pressure of the main engine reversing units, reversible transmissions or propellers.

1.5.10.3 Where vessels have only one main engine, that engine is not to be shut down automatically except in order to protect against overspeed.

1.5.10.4 Where vessels have only one main engine, that engine may be equipped with an automatic device for the reduction of the engine speed only if an automatic reduction of the engine speed is indicated both optically and acoustically in the wheelhouse and the device for the reduction of the engine speed can be switched off from the helmsman's position.

1.5.10.5 Shaft bushings are to be designed in such a way as to prevent the spread of water-polluting lubricants.

1.6 MATERIALS AND WELDING

1.6.1 Materials intended for manufacture of machinery parts are to comply with the requirements of the appropriate chapters of Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships given in 1.13, 2.4, 2.5, 4.3, 5.3 to 5.5, 6.3 to 6.5, 7.1 to 7.5, 8.1 to 8.3 of Table 1.2.4 of the present Part, may be also selected according to the standards. In this case, the application of materials is subject to agreement with the Register during consideration of technical documentation.

1.6.2 Materials of parts listed under 2.2, 2.3, 2.4.1, 3.1, 5.1, 6.1 of Table 1.2.4 are subject to the Register technical supervision during manufacture.

Materials of parts of internal combustion engines are subject to the Register technical supervision in accordance with Table 1.6.2.

Table 1.6.2

Nos	Cylinder bore, in mm	Part No. according to Table 1.2.4
1	Up to and including 300	1.1, 1.5, 1.6, 1.7, 1.9
2	From 301 up to and including 400	1.1, 1.2, 1.3, 1.5, 1.6, 1.8, 1.9, 1.11, 1.13
3	More than 400	All parts from 1.1 to 1.13

At the discretion of the Register, technical supervision may also be required during manufacture of pipes and fittings of the pressure systems associated with the engine.

1.6.3 When alloy steels, including heat resistant, high temperature oxidation resistant and high tensile steels, or alloy cast iron are used for the machinery parts, the information on chemical composition, mechanical and special properties confirming suitability of the material for intended application is to be submitted to the Register.

1.6.4 Nodular graphite cast iron is allowed for use up to the working temperature of 300 °C, and grey cast iron – up to 250 °C.

1.6.5 Manufacture of the machinery parts with application of welding is to comply with the requirements of Part XIV "Welding" of Rules for the Classification and Construction of Sea-Going Ships.

2 INTERNAL COMBUSTION ENGINES

2.1 GENERAL

2.1.1 The requirements of the present Section apply to all internal combustion engines of power output 55 kW and above.

Application of these requirements to the internal combustion engines of power output less than 55 kW is subject to special consideration by the Register in each case.

The requirements for dual-fuel internal combustion engines are given in Section 3.

2.1.2 The internal combustion engines are to be so constructed as to comply with the requirements of Section 2, Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships.

2.1.3 Only internal-combustion engines burning fuels having a flashpoint of more than 55 °C may be installed.

3 DUAL-FUEL INTERNAL COMBUSTION ENGINES

3.1 GENERAL

3.1.1 The requirements of the present Section are applicable to dual-fuel compression ignition internal combustion engines (DF-engines), operating on liquid fuel and natural gas (methane).

3.2 CONDITIONS OF OPERATION ON TWO KINDS OF FUEL

3.2.1 When operated on two kinds of fuel, DF-engines are to be equipped with the arrangement for supply of starting fuel with further supply of gas fuel. The possibility of quick change-over from gas fuel to liquid fuel is to be provided.

3.2.2 Start of DF-engines is to be carried out on liquid fuel only.

3.2.3 When DF-engine runs in variable modes, under the ship's manoeuvring, mooring operations conditions, only liquid fuel is to be used.

3.2.4 In case of unexpected gas fuel cut off, DF-engine is to continue operation on liquid fuel without stop.

3.2.5 DF-engines are to be provided with sensors for blocking simultaneous feed of gas fuel and complete supply of liquid fuel.

3.3 CRANKCASE PROTECTION

3.3.1 Crankcases of DF-engines are to be fitted with safety valves in way of each crankshaft crank. Design and actuating pressure of safety valves are to be specified with due regard to the possible explosion of gas fuel leakage accumulated in the crankcase.

3.3.2 When a trunk-piston engine is used as DF-engine, the crankcase is to be protected as follows:

.1 ventilation of crankcases is to be provided to prevent accumulation of gas fuel leakage. Air pipe ends are to be led to a safe place and to be fitted with flame arresters;

.2 detectors of gas fuel leakage or any other equivalent equipment are to be installed. A device for automatic intake of inert gas is recommended for installation;

.3 oil mist detector is to be fitted in the crankcase.

3.3.3 When a crosshead-type engine is used as DF-engine, the engine crankcase is to be equipped with oil mist detector or temperature control system of the engine bearings.

3.4 PROTECTION OF SUB-PISTON SPACES OF CROSSHEAD TYPE DF-ENGINES

3.4.1 Sub-piston spaces are to be provided with gas fuel leakage detectors or with other equivalent devices.

3.5 INTAKE AND EXHAUST GAS SYSTEMS

3.5.1 Intake pipelines and supercharge air receivers, as well as exhaust gas collectors are to be fitted with safety valves or other protective devices.

3.5.2 Exhaust gas pipelines from DF-engines are not to be combined with exhaust gas pipelines from other engines, boilers and incinerators.

3.6 STARTING AIR PIPELINES

3.6.1 Branch pipes of starting air pipelines laid to each cylinder are to be equipped in compliance with the requirements of 2.9.2.

3.7 COMBUSTION CONTROL

3.7.1 The scope of combustion control is to be determined and submitted for approval with due regard for the failure mode-and-effects analysis for all elements of DF-engines affecting the combustion process.

The minimum scope of control, types of automatic protection and alarms are given in Table 3.7.1.

3.8 GAS FUEL SUPPLY

3.8.1 At the inlet of gas fuel supply collector to the DF-engine cylinder a flame arrester is to be fitted.

3.8.2 An arrangement for manual cutt-off of gas fuel supply to DF-engine from the local control station is to be provided.

3.8.3 Gas fuel supply pipelines are is to meet the requirements of Section 13, Part VII "Systems and Piping".

3.9 GAS FUEL SUPPLY CUT-OFF

3.9.1 Gas fuel supply to DF-engines cut-off by means of automatic closing of valves on the engine is to be performed when DF-engine has stopped due to any unknown reason or in cases specified in 3.3.2.2, 3.3.2.3, 3.3.3, 3.4.1, 3.7.1 of the present Part, and in 12.11.2.3 or 12.11.3.2, Part VII "Systems and Piping".

3.9.2 It is recommended to close automatically the main cut-off valve for gas fuel supply to the collector at the failure of gas fuel supply valves to DF-engine combustion chambers (refer to 3.7.1 of the present Part and 12.11.6, Part VII "Systems and Piping").

3.9.3 Gas fuel supply to DF-engines is to be automatically cut off when the concentration of gas in the engine room reaches 60 per cent of the lower inflammability level. The requirements of 3.2.4 are to be met.

Table 3.7.1

Nos	Controlled parameter or DF-engine component	Measurement point or monitoring conditions	Parameter limit values (alarm system) or fault symptoms	Automatic shut-down of gas fuel supply valves	Indication in the main machinery control room
1	Gas fuel injection valves and starting oil fuel injectors	Each cylinder	Seizing of gas fuel injection valve in open condition	×	Constantly
2	Exhaust gas temperature	At each cylinder outlet	Ignition failure		
		Deviation from average	Max	×	Constantly
3	Combustion pressure	In each cylinder	Max	×	Constantly
		Deviation from average	Max	×	Constantly
4	Gas fuel supply pressure	At engine inlet	Min	×	Constantly

N o t e . For gas fuel operation, in case of failure of gas fuel supply valves to DF-engines combustion chambers, automatic closing is to be provided for the main cut-off (pilot) valve for gas fuel supply to DF-engines.

4 GEARS, DISENGAGING AND ELASTIC COUPLINGS

4.1 GENERAL

4.1.1 The reverse-reduction gearing intended for propulsion is also to comply with the requirements of 2.1, Part VI "Machinery Installations" of the Rules.

4.1.2 Parts rotating at speeds of 5 to 20 m/s are to be statically balanced, while those rotating at speeds over 20 m/s are to be dynamically balanced. The accuracy of dynamic balancing is to be determined by the following formulae:

$$v = 2400/n \text{ at } v > 300 \text{ m/s}; \tag{4.1.2-1}$$

$$v = 63000/n \text{ at } v = 20 \text{ m/s} \tag{4.1.2-2}$$

where v = distance between the centre of gravity and the geometrical axis of the part concerned rotation, in mm;
n = rotation speed , in $\min^{-1}$;
v = peripheral velocity, in m/s.

For intermediate values of rotation speed between 20 and 300 m/s, the value of v is to be determined by interpolation.

Rigid elements of couplings are to be balanced together with the parts they rigidly adjoin.

4.1.3 The design of main gears is to provide an access to all bearings.

Gear casings are to have a sufficient number of sight openings with easily detachable covers for carrying out internal examination.

Sight openings are to be so arranged as to allow an examination of the teeth over the full length and of the bearings inside the gear.

The application of the present requirement to planetary gears is subject to special consideration by the Register in each case.

4.1.4 Gear casings are to be provided with venting arrangements.

Vent pipes of the gears with volume of 0,5 m^3 and above are to be led to the open deck or other position where uptake is provided.

Ends of vent pipes are to be fitted with flame-arresters and arranged so as to prevent water from penetrating into the gear.

4.1.5 Where the main thrust bearing is housed in the gear casing, the lower part of the casing is to have proper strengthening.

4.2 GEARING

4.2.1 The requirements of 4.2, Part IX "Machinery" of Rules for the Classification and Construction of Sea-Going Ships are to be met. For ice-strengthened ships, the factor accounting for the ice category is to be taken to be $K'_A = 1$.

4.2.2 Gearing shafts are to be made of steel with breaking stress not less than 440 MPa. The overall breaking stress of gearing shafts material is to be not less than that of the shaft line intermediate shafts material breaking stress.

4.3 ELASTIC AND DISENGAGING COUPLINGS

4.3.1 General.

4.3.1.1 The requirements of the present Chapter apply to elastic and disengaging couplings of main and auxiliary machinery. As far as practicable, these requirements apply to electromagnetic and hydraulic disengaging couplings as well.

4.3.1.2 Rigid components of shaft couplings material are to meet the requirements of 1.3, Part VI "Machinery Installations".

4.3.1.3 Coupling flanges and coupling bolts are to meet the requirements of 5.2 and 5.3, while keyless-fitted shaft couplings are to meet the requirements of 5.4, Part VI "Machinery Installations".

4.3.1.4 On ships with one main engine, the shaft coupling design is to ensure, in case of coupling failure, the ship's running at a speed sufficient for easy steering.

4.3.2 Elastic couplings.

4.3.2.1 Where the requirement of 4.3.1.4 is not complied with, the ultimate static moment of elastic components material, i.e. rubber or similar synthetic material, being in shear or tension, are to be at least eight times the torque transmitted by the coupling.

4.3.2.2 In calculation of the main machinery and diesel generator sets elastic coupling, additional loads due to torsional vibrations are to be considered (refer to Section 8, Part VI "Machinery Installations").

4.3.2.3 Elastic couplings of diesel generator sets are to absorb impact moments arising as a result of short-circuit. Where no such information is available, the maximum torque is to be at least 4,5 times the nominal torque of the coupling.

4.3.2.4 Provision is to be made for full loading of elastic components made of rubber or another synthetic material of main machinery plants and diesel generator sets couplings within the temperature range from 5 to 60 °C.

4.3.3 Disengaging couplings.

4.3.3.1 Disengaging couplings of the main machinery are to be provided with devices preventing continuous slipping.

4.3.3.2 It is to be possible to control disengaging couplings of the main machinery from the main machinery control stations.

Directly at disengaging couplings local reserve (emergency) control arrangements are to be provided.

4.3.3.3 Where two or more engines drive a single propeller shaft through disengaging couplings, their control arrangement is to make a simultaneous engagement of the engines impossible when running in opposite directions.

4.4 TURNING GEAR

4.4.1 A power-driven turning gear is to be provided with an interlocking precluding the possibility of gears and couplings engagement when the turning gear is engaged (refer also to 3.1.7, Part VI "Machinery Installations" and 2.11.1.4 of the present Part).

5 AUXILIARY MACHINERY

5.1 AIR COMPRESSORS

5.1.1 General.

5.1.1.1 Air inlets of compressors are to be fitted with strainers.

5.1.1.2 Compressors are to be so designed that the air temperature at the air cooler outlet does not exceed 90 °C, they are also to be provided with a signalling device or alarm system for exceeding the maximum temperature.

5.1.1.3 The compressor cooling water spaces are to be fitted with drain arrangements.

5.1.2 Safety devices.

5.1.2.1 A safety valve preventing the pressure rise in the compressor stage above 1,1 of the rated pressure when the delivery pipe valve is closed is to be fitted at each compressor stage or immediately thereafter.

The safety valve design is to prevent any possibility of its adjustment or disconnection after being fitted on the compressor.

5.1.2.2 Compressor crankcases of more than 0,5 m^3 in volume are to be fitted with safety valves meeting the requirements of 2.3.5 of the present Part.

5.1.2.3 Casings of coolers are to be fitted with safety devices providing a free air escape in case of pipe rupture.

5.1.3 Crankshaft.

5.1.3.1 The checking calculation method specified in 5.1.3.3 and 5.1.3.4 applies to steel crankshafts of shipboard air compressors with in-line, V- and W-shaped arrangement of cylinders and with single- and multi-stage compression.

Cast iron crankshafts, as well as deviations from the dimensions of steel crankshafts calculated by the Formulae (5.1.3.3) and (5.1.3.4) may be accepted on agreement with the Register, provided the supporting calculations or test data are submitted.

5.1.3.2 Crankshafts are to be made of steel having tensile strength of 410 to 780 MPa.

The use of steel having a tensile strength over 780 MPa is subject to special consideration by the Register in each case.

Cast iron crankshafts are to be made of spheroidal graphite cast iron of ferrite-perlite structure according to Table 3.9.3.1, Part XIII "Materials" of Rules for the Classification and Construction of Sea-Going Ships.

5.1.3.3 Crankpin diameter d_c, in mm, of the compressor is not to be less than that determined by the following formula:

$$d_c = 0{,}25k'\sqrt[3]{D_d^2\, p_c\sqrt{0{,}3L_d^2 f + (s\varphi_1)^2}} \qquad (5.1.3.3)$$

where D_d = design diameter of the cylinder, in mm; for single-stage compression $D_d = D$;

D = diameter of the cylinder, in mm; for two- and multi-stage compression in separate cylinders $D_d = D_{h.p.}$;

$D_{h.p.}$ = diameter of the high-pressure cylinder, in mm; for two-stage compression by a tandem piston $D_d = 1{,}4D_{h.p.}$; for two-stage compression by a differential piston:

$$D_d = \sqrt{D_{l.p.}^2 - D_{h.p.}^2}\ ;$$

$D_{l.p.}$ = diameter of the low-pressure cylinder, in mm;

p_c = delivery pressure of the high-pressure cylinder for air compressors, in MPa, for refrigerant compressors, the value p_c is to be taken in accordance with 2.2.2, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships;

L_d = design span between main bearings, in mm;

$L_d = L'$ when one crank is arranged between two main bearings;

$L_d = 1{,}1L'$, when two cranks are arranged between two main bearings;

L' = actual span between centres of main bearings, in mm;

s = piston stroke, in mm;

k', f, φ_1 = coefficients taken in accordance with Tables 5.1.3.3-1, 5.1.3.3-2 and 5.1.3.3-3.

Table 5.1.3.3-1

Values of coefficient k'

Tensile strength R_m, in MPa	390	490	590	690	780	900
k'	1,43	1,35	1,28	1,23	1,2	1,18

Table 5.1.3.3-2

Values of coefficient f_1

Angle between the cylinder axes	0° (in-line)	45°	60°	90°
f_1	1,0	2,9	1,96	1,21

Table 5.1.3.3-3

Values of coefficient φ_1

Number of cylinders	1	2	4	6	8
φ_1	1,0	1,1	1,2	1,3	1,4

5.1.3.4 Thickness of the shaft web h_c, in mm, is to be not less that that determined by the following formula:

$$h_c = 0{,}105 k_1 D_d \sqrt{(\psi_1 \psi_2 + 0{,}4) p_c c_1 f_1 / b} \qquad (5.1.3.4)$$

where $k_1 = a \sqrt[3]{R_m/(2R_m - 430)}$;

R_m = tensile strength of material, in MPa; where the material with the tensile strength exceeding 780 MPa is used, R_m equal to 780 MPa is to be adopted for calculation;

a = 0,9 in case of shafts the surface of which is completely nitrided or hardened by another method approved by the Register;

a = 0,95 in case of shafts forged by close-die or continuous grain-flow method;

a = 1 in case of shafts not subjected to hardening;

k_1, ψ_1, ψ_2 = coefficients taken in accordance with Tables 5.1.3.4-1 and 5.1.3.4-2;

p_c = delivery pressure taken in accordance with 5.1.3.3;

c_1 = distance from the centre of the main bearing to mid-plane of the web; for cranks arranged between two main bearings, the distance is taken to the mid-plane of the web remotest from the support, in mm;

b = web thickness, in mm;

f_1 = coefficient taken in accordance with Table 5.1.3.4-3.

Table 5.1.3.4-1

Values of coefficient ψ_1

r/h	ε/h						
	0	0,2	0,4	0,6	0,8	1,0	1,2
0,07	4,5	4,5	4,28	4,10	3,70	3,30	2,75
0,10	3,5	3,5	3,34	3,18	2,88	2,57	2,18
0,15	2,9	2,9	2,82	2,65	2,40	2,07	1,83
0,20	2,5	2,5	2,41	2,32	2,06	1,79	1,61
0,25	2,3	2,3	2,20	2,10	1,90	1,7	1,4

Note. r = fillet radius, in mm; ε = absolute amount of overlapping, in mm (refer to Fig. 5.1.3.4); for crankshafts having the distance x between journals and pins the values of coefficient ψ_1 are to be taken valid for ratio ε/h = 0.

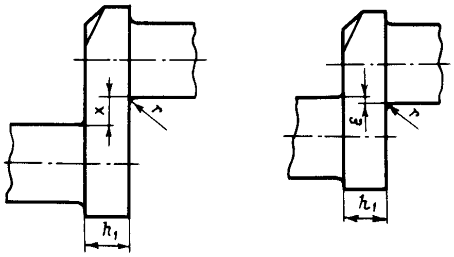


Fig. 5.1.3.4

Table 5.1.3.4-2

Values of coefficient ψ_2

b/d	1,2	1,4	1,5	1,8	2,0	2,2
ψ_2	0,92	0,95	1,0	1,08	1,15	1,27

Table 5.1.3.4-3

Values of coefficient f_1

Angle between the cylinder axes	0° (in-line)	45°	60°	90°
f_1	1,0	1,7	1,4	1,1

Intermediate values of coefficients given in the tables are determined by linear interpolation.

5.1.3.5 Shafts designing and manufacturing are to comply with the requirements of 2.4.12 to 2.4.13.

5.1.4 Instruments.

5.1.4.1 A pressure gauge is to be fitted after each stage of the compressor.

5.1.4.2 Provision is to be made for measuring the air temperature at the delivery pipe immediately after the compressor.

5.1.4.3 Instruments of the attached compressors are subject to special consideration by the Register in each case.

5.2 PUMPS

5.2.1 General.

5.2.1.1 Provision is to be made to prevent the pumped fluid from penetration into the bearings. However, this does not apply to the pumps where the pumped fluid is employed for lubrication of bearings.

5.2.1.2 The pump glands arranged on the suction side are recommended to be fitted with hydraulic seals.

5.2.2 Safety devices.

5.2.2.1 If the pump design does not preclude the possibility of pressure rising above the rated value, a safety valve is to be fitted on the pump casing or on the pipeline before the first stop valve.

5.2.2.2 In pumps intended for pumping over flammable liquids, the transfer from safety valves is to be effected into the suction space of the pump or to the suction part of the pipeline.

5.2.2.3 Provision is to be made to prevent hydraulic impacts; the use of by-pass valves for this purpose is not recommended.

5.2.3 Strength calculations.

5.2.3.1 The critical rotation speed of the pump rotor is not to be less than 1,3 of the rated one.

5.2.3.2 The pump components are to be checked for strength under stresses corresponding to the pump rated parameters. In this case, the reference stresses are not to exceed 0,4 R_{eH} of the component material.

5.2.4 Self-priming pumps.

5.2.4.1 The pumps provided with self-priming devices are to ensure operation under "dry suction" conditions and are, generally, to be fitted with arrangements preventing the self-priming device from operating with contaminated water.

5.2.4.2 Self-priming pumps are to have place for connecting a vacuum pressure gauge.

5.2.5 Attached pumps.

5.2.5.1 All the pumps attached on the engine are to be so designed as to ensure supply to the engine under all operating conditions of the engine.

5.2.6 Additional requirements for the pumps transferring flammable liquids.

5.2.6.1 Sealing of the shaft is to be such that the leakages occurred do not cause the formation of vapours and gases in the amount sufficient to produce the flammable air/gas mixture.

5.2.6.2 The possibility of excessive heating and ignition in sealings of rotating parts due to friction energy is to be excluded.

5.2.6.3 When the materials of low electrical conductivity (plastics, rubber, etc.) are used in the pump structure, provision is to be made for removal of electrostatic charges by insertion of conductive additives into them or by use of devices for removal of charges and for their transfer to the frame.

5.2.7 Additional requirements for cargo, stripping and ballast pumps on oil tankers.

Casings of the pumps installed in cargo pump rooms in accordance with 4.2.5, Part VI "Machinery Installations" are to be provided with temperature sensors.

5.3 FANS, BLOWERS AND TURBOCHARGERS

5.3.1 General.

5.3.1.1 The requirements of the present Chapter are to be complied with during design and manufacture of fans intended to make up the systems specified in Part VII "Systems and Piping", as well as of boiler fans and internal combustion engine turbochargers.

5.3.1.2 Rotors of fans and air blowers together with couplings as well as turbochargers rotor assemblies are to be balanced in accordance with 4.1.2.

5.3.1.3 Suction pipes of fans, blowers and turbochargers are to be protected against entry of foreign materials.

5.3.1.4 The lubricating oil system of the turbocharger bearings is to be so arranged as to prevent lubricating oil from penetrating into the supercharge air.

5.3.2 Strength calculations.

Impellers of turbines and blowers are to be so dimensioned that at rotation speed equal to 1,3 of the rated one the reference stresses at any section are not exceed $0{,}95R_{eH}$ of the component material.

Impellers of turbines and blowers are to be also tested for strength during at least 3 min at rotation speed equal to 1,2 times the rated one.

Such testing of the prototype of turbine and blower impellers is mandatory.

Series specimens may not be subjected to such testing, provided each impeller forging is to be tested by one of the approved non-destructive methods.

5.3.3 Additional requirements for ventilators of cargo pump rooms on oil tankers.

5.3.3.1 The air gap between the impeller and the ventilator casing is to be not less than 0,1 of the impeller shaft bearing diameter, but in all cases not less than 2 mm (it is allowed to be not more than 13 mm).

5.3.3.2 Protection gauzes of not more than 13 mm square mesh are to be fitted at the inlet and outlet of vent ducts to prevent penetration of foreign objects into the fan casing.

5.3.3.3 To prevent electrostatic charges from being accumulated both in the rotating parts and the casing, they are to be made of antistatic materials. Furthermore, installation of ventilation units on board the ship is to be such as to ensure their safe earthing to the ship's hull according to the requirements of Part IX "Electrical Equipment".

5.3.3.4 The impeller and the casing (in way of possible contact with the impeller) are to be made of sparkproof materials.

The following combinations of impeller and casing materials are considered to be sparkproof:

.1 non-metallic antistatic materials;

.2 non-ferrous-based alloys;

.3 austenitic stainless steel;

.4 impeller is made of aluminium alloy or magnesium alloy and casing is made of cast iron or steel (austenitic stainless steel included), if a ring of the relevant thickness made of non-ferrous-based alloys is fitted inside the casing in way of impeller;

.5 any combination of cast iron and steel impellers and casings (including the case when impeller or casing is made of austenitic stainless steel), provided the tip clearance is not less than 13 mm.

5.3.3.5 Other combinations of impellers and casings materials, not specified in 5.3.3.4, may also be allowed if they are recognized as non-sparking by the appropriate tests.

5.3.3.6 The following combinations of impeller and casing materials are not allowed:

.1 impellers are made of aluminium or magnesium alloys, while casings are made of ferrous-based alloys;

.2 impellers are made of ferrous-based alloys, while casings are made of aluminium or magnesium alloys;

.3 impellers and casings are made of ferrous-based alloys with less than 13 mm tip clearance.

5.4 CENTRIFUGAL SEPARATORS

5.4.1 General.

5.4.1.1 Separators design is to preclude the leakage of oil products and their vapours under all separation conditions.

5.4.1.2 Separator bowls are to be dynamically balanced. The position of removable parts is to be marked. The design of the disc holder and the bowl is to preclude the possibility of their misassembly.

5.4.1.3 "Rotor – stator" systems are to be so designed that the critical rotation speed exceeds the operating rotation speed both in empty and in filled condition.

The critical rotation speed less than the rated rotation speed may be allowed only if proofs for continuos safe operation of the separator are submitted.

5.4.1.4 The design of couplings is to preclude the possibility of spark formation and impermissible heating under all operation conditions of the separator.

5.4.2 Strength calculations.

5.4.2.1 Rotating parts of the separator are also to be checked for strength under stresses arising at rotation speeds exceeding the design rotation speed at least by 30 per cent; in this case, the total stresses in the parts concerned are not to exceed 0,95R_{eH} of their material.

5.4.2.2 At the Manufacturer's test bench, the strength of the rotating parts of the prototype separator are to be tested at rotation speed exceeding the rated rotation speed by at least 30 per cent.

5.4.3 Instruments and protection.

5.4.3.1 A device for the control over the separation process is to be provided.

5.4.3.2 It is recommended to provide separators with a device automatically disconnecting the drive and stopping the separator when inadmissible vibration occurs.

6 DECK MACHINERY

6.1 GENERAL

6.1.1 Machinery intended for installation on the open deck is to be designed proceeding from their operation conditions at the ambient air temperature from – 20 up to +40 °C.

In special cases, subject to agreement with the Register, other temperature ranges may be established.

6.1.2 Brake straps and their fastenings are to be resistant to sea water and petroleum products. Brake straps are to be heat-resistant at temperatures up to 250 °C. The permissible heat resistance of connections between the brake strap and the frame is to be above the temperature of heating of the connections for all possible operating conditions of the machinery.

6.1.3 The machinery having both manual and power drives is to be provided with interlocking arrangements preventing their simultaneous operation.

6.1.4 The deck machinery controls are to be so made that heaving-in is performed when the handwheel is turned to the right or when the lever is pulled back while veering-out is carried on when the handwheel is turned to the left or the lever is pushed forward. Locking of brakes is to be carried out by turning handwheels to the right, whole releasing is effected by turning to the left.

6.1.5 Hand forces required to shift control levers and handwheels are to be taken as low as possible, depending on the frequency of use of the controls.

For controls used during short periods of time, a hand force not more than 160 N and a foot force not more than 300 N may be allowed. The one-time force applied upwards to the levers (e.g. disengaging device) is allowed to be up to 750 N per operator.

6.1.6 The rope ends are to be reliably secured to the winch drum. Winch drums are to have flanges protruding above the upper working layer of winding by not less than 2,5 times the rope diameter and by not less than 1,5 times the rope diameter above the last layer of fully wound rope.

When the rope is unwound, at least three safety coils of the rope are to remain on the drum.

6.1.7 Winches are to develop the necessary pull on the middle layer of winding on the drum. The safety margin specified in the appropriate Chapters in respect to the nominal pull is to be ensured at the load applied to the middle layer of winding on the drum. However, under unfavourable load conditions, the safety margin is to be not less than 2.

6.1.8 Hand operated winches, except for coupling winches, are to develop nominal pull in the rope under the action of a hand force equal to 160 N per drive handle and at the five-fold hand force, not more than 85 per cent of the breaking force of the rope on the lowest layer of winding on the winch drum.

6.2 STEERING GEAR

6.2.1 Power of steering gear.

6.2.1.1 Steering gear is to provide continuous operation at the permanent heel up to 15° and permanent trim up to 5°, and ambient temperatures from −20 to +50 °C. Steering gear power units are to permit a torque overload equal to 1,5 times the rated torque for a period of 1 min.

Steering gear electric motors are to comply with the requirements of Part IX "Electrical Equipment".

6.2.1.2 Steering gear is to be capable of putting the rudder (steering nozzle) according to 2.9.6 and, accordingly, 2.9.7, Part III "Equipment, Arrangements and Outfit".

6.2.1.3 Steering gear is to provide continuous operation under the most severe service conditions. Steering gear power units are to permit a torque overload of at least 1,5 times the rated torque for a period of 1 min. Steering gear electric motors are to comply with the requirements of 5.5, Part IX "Electrical Equipment".

6.2.2 Hand-operated and reserve steering gear.

6.2.2.1 The main hand-operated steering gear is to be of self-braking design or to have a normally applied braking device. The reserve hand-operated steering gear is to be of self-braking design or to have a locking device provided that it is reliably controlled from the control station.

6.2.2.2 The main hand-operated steering gear is to meet the requirements of 5.2.1.1 when handled by one helmsman with a force of not over 40 N applied to the steering wheel handles and with the speed not more than 25 r.p.m. during shifting the rudder from hard over to hard over.

6.2.2.3 The reserve hand-operated steering gear is to meet the requirements of 5.2.1.2 when handled with a force of not more than 40 N per helmsman applied to the steering wheel handles.

6.2.2.4 The reserve steering gear is to be independent from the main steering gear and, where possible, actuate directly the rudder stock. The steering gear is to be so designed as to provide changing from the main steering gear to the reserve one to be performed from the control station during not more than 5 s.

6.2.2.5 The manual wheel is not to be driven by a powered drive unit.

6.2.2.6 Regardless of rudder position, a kick-back of the wheel is to be prevented when the manual drive is engaged automatically.

6.2.3 Mechanically-driven, remotely controlled steering gear.

6.2.3.1 Chains, steering ropes and galvanized wire ropes of steering gear are to be provided with devices to take up the slack. Besides, the steering rope line at each side is to incorporate spring buffers. Gear components of the steering gear are to comply with the standards recognized by the Register.

6.2.3.2 Rudder indicators and their gears, hinges and couplings are to be so designed and installed that in case of the ship's hull deformation due to cargo shifting or rough sea the possibility of the steering gear jamming or damage of the transmission components is precluded.

6.2.4 Protection against overload and reverse rotation.

6.2.4.1 Steering gear is to have protection against overloads of gear components and assemblies when a rudder stock torque equal to 1,5 times the rated value arises.

6.2.4.2 For hydraulic steering gear safety valves may be used if set to a pressure meeting the above-mentioned requirement, but not in excess of 1,5 times the rated working pressure.

6.2.4.3 For the hand-operated steering gear it is sufficient to provide the gear with buffer springs instead of protection against overload.

If a hand-operated steering gear is used as reserve steering gear, the protection against overload is not required.

6.2.4.4 Pumps of hydraulic steering gear are to be provided with protective devices preventing rotation of the inoperative pump in the opposite direction or with an automatic arrangement shutting out the flow of liquid through the inoperative pump.

6.2.4.5 The steering gear is to be so constituted that no external forces applied to the rudder shall impair the operating capacity of the steering equipment and its controls. The rudder position is not to change unexpectedly.

6.2.5 Braking device.

6.2.5.1 Steering arrangement is to be fitted with a brake or some other device keeping the rudder steady in any position when the latter exerts a rated torque without allowing for the efficiency of the rudder stock bearings.

6.2.5.2 Where machinery components of the hydraulic steering gear can be locked by closing the oil pipeline valves, a special braking device may be omitted.

6.2.6 Limit switches and rudder indicators.

6.2.6.1 Each power-operated steering gear is to be provided with a device discontinuing its operation before the rudder reaches the rudder stops specified in 2.10.1, Part III "Equipment, Arrangements and Outfit".

6.2.6.2 Steering machinery is to be equipped with remotely operating rudder indicators. The steering gear segment rack or the hydraulic steering gear crosshead guide, or the component rigidly coupled with the rudder stock are to have graduation calibrated in not more than 1° to indicate the actual position of the rudder.

6.2.7 Strength calculations.

6.2.7.1 The main and reserve steering gear components to be used in the flux of force lines are to be checked for strength under the stress corresponding to the rated torque. The reduced stresses in the components are not to exceed $0{,}4R_{eH}$ of the component material.

6.2.7.2 The stresses in components common for both the main and reserve steering gear (tiller, segment, reduction gear, etc.) are not to exceed 80 per cent of the stresses tolerable in conformity with 6.2.7.1.

6.2.7.3 Steering gear components unprotected from overloads by safety devices specified in 6.2.4 are to have strength not less than the rudder stock strength.

6.2.8 Connection with the rudder stock.

6.2.8.1 Connection of the steering gear with the elements rigidly coupled with the rudder stock is to eliminate the possibility of the steering gear break-down when the rudder stock is shifted in axial direction by 0,1 of the rudder stock diameter.

6.2.8.2 The method of connecting the tiller hub or segment rack with the rudder stock is subject to special consideration by the Register.

The height of hubs, loose segment racks and auxiliary tillers is not to be less than 0,8 of the diameter of the rudder stock head.

The outside diameter of the hub is to be not less than 1,6 of the rudder stock head diameter.

6.2.8.3 Split hubs are to be fastened with at least two bolts on each side and have two keys arranged at an angle of 90° to the split joint plane.

6.2.9 Additional requirements.

Hydraulic steering gear is to meet the requirements of Section 7 of the present Part and of Part III "Equipment, Arrangements and Outfit" of the Rules.

6.2.10 Steering apparatus drive unit.

6.2.10.1 If the steering apparatus has a powered drive unit, it is to be possible to bring a second independent drive unit, or manual drive, into use within five seconds if the steering apparatus drive unit fails or malfunctions.

6.2.10.2 If the second drive unit or manual drive is not placed in service automatically, it is to be possible to do so immediately by means of a single operation by the helmsman that is both simple and quick.

6.2.10.3 The second drive unit or manual drive is to ensure the manoeuvrability required by 2.9.7, Part III "Equipment, Arrangements and Outfit".

6.3 ANCHOR MACHINERY

6.3.1 Drive.

6.3.1.1 The drive power of the anchor machinery is to ensure the ship's pulling towards the anchor, releasing and hoisting any of the anchors at a speed not less than 0,15 m/s with the nominal pull on the sprocket F, in N, determined by the following formula:

$$F = 22{,}6md^2 \qquad (6.3.1.1)$$

where m = strength factor equal to:
1 for ordinary stud link chain cables;
0,9 for studless link chain cables;
d = anchor chain diameter, in mm.

6.3.1.2 The drive is to provide an uninterrupted heaving-in of the anchor chain at a speed and pull specified in 6.3.1.1 for a period of at least 30 min, as well as paying out of one anchor to an assumed depth of the anchorage equal to 1/3 of the anchor chain length as determined by Part III "Equipment, Arrangement and Outfit".

6.3.1.3 As the anchor approaches the hawse, the drive is to provide heaving-in speed not over than 0,12 m/s.

6.3.1.4 The starting torque of the anchor machinery drive is to build up a pull on a sprocket with the anchor chain immovable not less than $2F$.

6.3.1.5 The drive is to provide a simultaneous hoisting of two anchors from an assumed depth of the anchorage.

6.3.1.6 The force applied to the reserve hand drive is to be not more than 160 N per operator with the 0,6 of the nominal pull ensured.

When using rocking drives, the force per one operator is not to exceed 200 N.

6.3.1.7 Anchor machinery provided with power drive developing a nominal pull below 17000 N is to have an additional hand drive.

6.3.1.8 The hand drive of the anchor machinery may be accepted as a main drive if the anchor mass is less than 50 kg. In this case, the drive is to have a worm gear and be self-braking.

6.3.2 Brakes and clutches.

6.3.2.1 The anchor machinery is to be fitted with clutches arranged between the sprocket and its drive shaft.

The anchor machinery is to be provided with brakes. The anchor machinery with electric or diesel drives is to be provided with automatic brakes fitted on the drive shaft and switched in when the drive is shut down or failed.

Where a self-braking drive is provided, the automatic brake may be omitted.

6.3.2.2 The automatic brake is to ensure a braking torque corresponding to a force in the chain on the sprocket not less than $2F$.

6.3.2.3 Each chain sprocket is to be fitted with a brake, the braking torque of which with the sprocket disconnected from the drive is to provide holding of the anchor chain without slipping of the brake on exposure to the force in the chain:

.1 equal to 0,45 of the breaking load in the chain where the anchor gear is provided with the anchor chain stopper intended for anchorage;

.2 equal to 0,8 of the braking load in chain without the above-mentioned stopper.

The force applied to the brake drive handle is not to exceed 750 N.

6.3.3 Chain sprockets.

6.3.3.1 Chain sprockets are to have not less than five cams. For horizontal shaft sprockets the wrapping angle is to be not less than 115°, while for vertical shaft sprockets, not less than 150°.

6.3.3.2 Chain sprockets are to ensure passing the joining links in both horizontal and vertical positions.

Chain sprockets of vertical shaft anchor winches are to ensure passing the joining links in vertical position.

6.3.4 Overload protection.

6.3.4.1 If the machinery drive is capable of developing a torque which builds up an effort on the sprocket exceeding 0,6 of the anchor chain test load or generates stresses in the anchor machinery components exceeding $0{,}95R_{eH}$, provision is to be made for a safety arrangement installed between the drive and the machinery to prevent exceeding the above-mentioned load.

6.3.5 Strength calculations.

6.3.5.1 The anchor machinery components under load are to be checked for strength when affected by efforts corresponding to the maximum torque of the drive or to the moment of the extreme protection setting. The reference stresses in the components are not to exceed $0{,}95R_{eH}$ of the component material. Under the action of the nominal pull, the stresses are not to exceed $0{,}4R_{eH}$ of the material.

6.3.5.2 The anchor machinery components under load with the sprocket braked are to be checked for strength when affected by the anchor chain breaking load. In this case, the stresses are not to exceed $0{,}95R_{eH}$ of the material.

6.3.6 Additional requirements.

6.3.6.1 The anchor machinery intended for mooring operations is to comply with the requirements of 6.4, in addition to those of the present Chapter.

6.3.6.2 Hydraulically driven anchor machinery is to meet the requirements of Section 7.

6.4 MOORING MACHINERY

6.4.1 Drive.

6.4.1.1 The mooring machinery drives are to provide uninterrupted heaving-in of a mooring line at a rated pull with the rated speed for a period of not less than 30 min. The speed of heaving in a mooring rope at a rated pull is not, as a rule, to exceed 0,3 m/s. Besides, provision is to be made for heaving in a mooring rope with a speed not exceeding 0,15 m/s.

6.4.1.2 The mooring machinery drive is to be capable of developing a pull in the rope not less than twice the rated pull within 15 s.

6.4.2 Overload protection.

If the maximum torque of the drive may bring about a larger load on the mooring machinery components than that specified in 6.4.4, an overload protection is to be provided.

6.4.3 Brakes.

6.4.3.1 The mooring machinery is to be provided with an automatic brake. The brake is to hold against 1,5 times the rated pull affecting the mooring machinery drum.

6.4.3.2 The automatic mooring winch is to be provided with a brake fitted on the winch drum, which holds against the breaking load in the mooring line.

6.4.4 Strength calculations.

6.4.4.1 The mooring machinery components located in lines of the force flow are to be checked for strength when affected by forces corresponding to the maximum torque of the drive or to the moment of the extreme protection setting. The reduced stresses are not to exceed $0{,}95R_{eH}$ of the material.

Under the effect of the rated pull, the stresses are not to exceed $0{,}4R_{eH}$ of the material.

6.4.5 Automatic mooring machinery.

6.4.5.1 Automatic mooring machinery is to be equipped with manual control to provide the possibility of non-automatic operation.

6.4.5.2 The automatic mooring machinery is to be provided with:

sound warning alarm actuated when the permissible length of the mooring rope is veered out;

an indicator of the actual pull in the mooring rope during the automatic operation.

6.4.5.3 The mooring machinery components located, with the drum braked, in the flux of force lines introduced by the rope pull into the mooring machinery, are to be checked for strength when affected by the mooring rope breaking load.

6.5 TOWING WINCHES

6.5.1 Devices for governing the tension of the towing rope.

6.5.1.1 Where automatic devices for governing the tension of the towing rope are used, provision is to be made to enable checking the value of the tension at every moment. The tension indicators are to be installed near the towing winch and on the bridge.

6.5.1.2 Sound warning alarm operating when the maximum permissible length of the towing rope is veered out is to be provided.

6.5.1.3 In case of emergency, a possibility is to be provided to veer out the towing rope, to disconnect the rope drum or to ensure free paying-out the towing rope from both the local and remote control stations.

6.5.2 Brakes.

Towing winches are to be provided with a brake having holding capacity less than the breaking load of the towing rope.

6.5.3 Strength calculatons.

6.5.3.1 The towing winch components located in lines of force flow are to be checked for strength when affected by forces corresponding to the maximum torque of the drive. Stresses in the components in this case are not to exceed $0{,}95R_{eH}$ of the material. Under the rated rope pull applied to the middle layer of winding stresses in the components are not to exceed $0{,}4R_{eH}$ of the component material.

6.5.3.2 With the rope drum braked, the towing winch components located in lines of force flow introduced into the winch by the rope pull are to be checked for strength when a force equal to the breaking load of the towing rope is applied to the outer layer of winding. Stresses in the components are not to exceed $0{,}95R_{eH}$ of the component material in this case.

6.6 COUPLING WINCHES

6.6.1 Drives.

6.6.1.1 Drives of coupling winches are to be such that the heaving-in speed does not exceed 0,15 m/s.

6.6.1.2 Drives of coupling winches are to produce a pre-tension force of the rope equal at least to 0,2 of the breaking load of the rope as a whole. The hand force required to produce the pre-tension force of the rope is not to be less than 750 N.

6.6.2 Overload protection.

If the driving engine of the coupling winch is capable of producing the pre-tension forces exceeding 0,5 of the breaking load of the rope, an overload protection is to be provided.

6.6.3 Interlocking devices and brakes.

Coupling winches are to be provided with interlocking devices and brakes meeting the following requirements:

.1 interlocking devices are to be geometrically cheated;

.2 when the rope is being tensioned the interlocking device is to operate automatically;

.3 interlocking devices are to be capable of releasing when a force equal to the breaking load of the rope is attained;

.4 coupling winches are to be provided with brakes to prevent uncontrolled unwinding of the coupling rope when the interlocking device is released.

6.6.4 Strength calculations.

6.6.4.1 The coupling winch components located in the force flow of the drive are to be calculated for strength when affected by the forces mentioned in 6.6.2. The reference stresses in this case are not to exceed $0{,}95R_{eH}$ of the material. Under effects of the forces equal to the pre-tension of the rope as applied to the middle layer of winding on the drum, the reference stresses are not to exceed $0{,}4R_{eH}$ of the material.

6.6.4.2 The coupling winch components exposed to loads during operation of the interlocking device due to the coupling rope pull are to be calculated for breaking load of the rope as a whole as applied to the first layer of the rope wound on the winch drum. In this case, the reference stresses are not to exceed $0{,}95R_{eH}$ of the material.

6.6.5 Additional requirements.

The design of the device for securing the rope ends to the drums is to be reliable and preclude jamming of the rope between the drum flange and the winch frame.

7 HYDRAULIC DRIVES

7.1 GENERAL

7.1.1 No other power consumers may be connected to the hydraulic steering apparatus drive unit. Where there are two independent drive units, such a connection to one of the units is however acceptable if the consumers are connected to the return line and may be disconnected from the drive unit by means of an isolating device.

7.1.2 Where there are two hydraulic drive units, a separate hydraulic reservoir is needed for each of the two units. However, double reservoirs are acceptable. Hydraulic reservoirs shall be fitted with a warning system that monitors any drop in the oil level below the lowest content level needed for reliable operation.

7.1.3 The pilot valve does not have to be duplicated if this can be actuated manually or by manually-controlled hydraulic actuation from the wheelhouse.

7.1.4 The dimensions, design and arrangement of the pipework shall as far as possible exclude mechanical damage or damage resulting from fire.

7.1.5 As far as hydraulic drive units are concerned, no separate pipework system shall be required for the second unit if independent operation of the two units is guaranteed and if the pipework system is able to withstand a pressure of at least 1,5 times that of the maximum service pressure.

7.1.6 Flexible piping is only permitted where its use is essential in order to damp vibrations or to allow freedom of movement of components. It shall be designed for a pressure that is at least equal to the maximum service pressure.

7.1.7 Hydraulic systems of the main and reserve steering gear are to be independently provided with a pump and a drive. Where the second pump is driven from an auxiliary engine, which is not continuously operating, the pump drive is to be provided with a buffer system during the start of the auxiliary engine.

7.1.8 The main and reserve steering gear systems may have common components, mainly, cylinders, provided they are capable of operating independently.

7.2 STRENGTH CALCULATIONS

7.2.1 The hydraulic machinery components located in lines of force flow are to be checked for strength under the stresses corresponding to the working pressure. In this case, the reference stresses in components are not to exceed $0{,}4R_{eH}$ of the component material.

7.2.2 In cases specified in 6.2.4.1, 6.3.5.1 and 6.4.4, components are to be checked for strength under the stresses corresponding to the safety valves opening pressure. In this case, the reference stresses in components are not to exceed $0{,}95R_{eH}$ of the component material.

7.2.3 Pipelines and fittings of hydraulic systems are to comply with the requirements of 1.3 and 1.4, Part VII "Systems and Piping".

7.3 SAFETY AND OTHER ARRANGEMENTS

7.3.1 Hydraulic machinery is to be protected by safety valves operating pressure of which is not to exceed 1,1 times the maximum nominal pressure, except for the cases specified in 6.2.4.1, 6.3.5.1 and 6.4.4.

7.3.2 The working fluid from the safety valve is to be led to the suction pipeline or to the oil tank.

7.3.3 Arrangements for complete air expulsion when filling the machinery and the pipeline with the working fluid, as well as for leakage replenishment and drainage are to be provided.

7.3.4 Hydraulic systems are to be provided with filters of the appropriate capacity and filtration purity of the working fluid. For continuously operating hydraulic systems ensuring safe propulsion of the ship (hydraulic steering gear, hydraulic couplings etc.) provision is to be made for filter cleaning without interruption of working fluid circulation.

7.3.5 In case of the hydraulic steering gear provision is to be made for a fixed storage tank for hydraulic fluid with the capacity sufficient to fill at least one power actuating system, the equalizing tank included. The fixed tank is to be provided with a water level indicator and be connected to the hydraulic gear by the pipeline so as its hydraulic systems can be filled directly from the tiller room.

Each equalizing tank is to be provided with a minimum water level alarm.

7.3.6 Pipes of hydraulic steering gear systems are to comply with the requirements for Class I pipelines of Part VII "Systems and Piping".

The requirements for flexible joints used for hydraulic steering gear systems are specified in 2.1.8, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

8 WHEELHOUSE HOISTING ARRANGEMENT

8.1 STRUCTURAL REQUIREMENTS

8.1.1 If the ship is designed with a hoisting wheelhouse, the wheelhouse is to be lowered either by mechanical drive, or by its own weight.

Where mechanical drive is used, in emergency the wheelhouse is to be lowered by its own weight.

8.1.2 Hoisting and lowering are not to interfere with operations performed from the wheelhouse.

8.1.3 The appliance for hoisting and lowering is to enable the wheelhouse to be stopped and held in any given position.

8.1.4 Provision is to be made for automatically disconnecting the hoisting machinery when extreme positions are reached.

8.1.5 The hoisting machinery is to enable gradual deceleration of the wheelhouse when approaching extreme positions, or buffer arrangements are to be provided.

8.1.6 Lowering of the wheelhouse is to be performed by one person either from the wheelhouse, or from a control station located outside the wheelhouse.

8.1.7 The use of self-braking hoisting machinery is not allowed.

PART IX. ELECTRICAL EQUIPMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to electrical installations of inland navigation ships subject to the Register survey, as well as to the individual types of electrical equipment in accordance with 1.3.

1.1.2 The electrical equipment not specified in 1.3 is to be designed and manufactured in compliance with national standards in such a way that its malfunction does not result in fire or electric shock.

1.1.3 For floating structures and ships with electrical equipment supplied from the extraneous source of power (i.e. from the source located outside these structures and ships), and also for ships (except passenger ships) in which the preset power of a generator does not exceed 6,3 kW (kVA) and the ship's mains voltage does not exceed a safe voltage respectively, on agreement with the Register deviations from the requirements of the present Part may be allowed.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to the general terminology of the Rules are given in Part I "Classification".

For the purpose of the present Part the following definitions have been adopted.

E m e r g e n c y s o u r c e o f e l e c t r i c a l p o w e r is a source of electrical power intended to supply the ship's necessary services in case of the loss of voltage on the main switchboard.

E m e r g e n c y l i g h t i n g is lighting of the ship's spaces and areas by means of lighting fixtures fed from the emergency transitional source of electrical power.

E m e r g e n c y t r a n s i t i o n a l s o u r c e o f e l e c t r i c a l p o w e r is a source of electrical power intended to supply the ship's necessary services from the moment of the loss of voltage on the main switchboard busbars until the emergency diesel generator starts running.

S a f e t y v o l t a g e is any voltage not dangerous to the personnel. This condition is considered to be satisfied if the windings of transformers, converters and other devices for voltage reduction are electrically separated and if the reduced voltage across these devices or sources of electrical power does not exceed:

50 V between poles for direct current;

50 V between phases or between phases and the ship's hull for alternating current.

S h a f t g e n e r a t o r s are generators driven by the main machinery and supplying the ship's mains or separate consumers.

E a r t h i n g is the electrical connection of the part of electrical equipment to be earthed to the ship's hull.

L i g h t n i n g p r o t e c t i o n z o n e is the area within the limits of which the ship's space is protected against direct lightning strokes.

S h i p ' s h u l l means all the ship's metal parts which have a reliable electrical connection to the outer metal shell plating. For ships with non-conducting hull, it is a special copper sheet having the area of not less than 0,5 m^2 and thickness of not less than 2 mm which is attached to the outside of the ship's shell plating at a level below the light load waterline and is used for earthing all the equipment installed on board the ship.

A i r t e r m i n a t i o n n e t w o r k is the upper part of a lightning protective system intended for the perception of atmospherics.

N o n - e s s e n t i a l s e r v i c e s are services which temporary disconnection does not impair the ship's safe navigation, safety of people and cargo on board the ship.

M a i n s o u r c e o f e l e c t r i c a l p o w e r is a source of electrical power intended to supply all electrical equipment and systems essential for maintaining the ship in normal operational and habitable condition without use therewith of the emergency source of electrical power.

E s s e n t i a l s e r v i c e s are services which normal operation ensures the ship's safe navigation, safety of people and cargo on board the ship; these services are covered by 1.3.2.1.

D o w n c o n d u c t o r is a conductor, which electrically connects the air termination network to the earthing.

S p e c i a l e l e c t r i c a l s p a c e s are spaces or locations intended exlusively for electrical equipment and accessible for attending personnel only.

N o t r e a d i l y i g n i t a b l e e l e c t r i c a l l y i n s u l a t i n g m a t e r i a l is a material which sustained the tests according to the requirements of Guidelines on Technical Supervision during Construction of Ships and Manufacture of Materials and Products.

E l e c t r i c a l i n s t a l l a t i o n o f l o w p o w e r is an electrical installation of the ship with the total power of supply sources up to 50 kW (kVA).

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General.

General provisions relating to the classification procedure, technical supervision during the ship's construction and equipment manufacture, surveys, as well as the requirements for technical documentation are given General Regulations for the Classification and Other Activity and Part II "Technical Documentation" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.3.2 Technical supervision of the ship's electrical equipment.

1.3.2.1 The following kinds of equipment, systems and devices are subject to technical supervision on board the ship:

.1 electric propulsion plant;

.2 main and emergency sources of electrical power;

.3 power and lighting transformers and converters used in the equipment, systems and devices listed in 1.3.2.1;

.4 distribution gear and control and monitoring panels;

.5 electric drives of auxiliaries ensuring the operation of the main machinery, steering gear, CP-propellers, anchor and mooring machinery, towing winches, machinery of launching appliances for lifeboats and liferafts, starting air and sound signal air compressors, bilge and ballast pumps, cargo pumps on oil tankers, pumps and compressors of fire extinguishing systems, machinery or watertight and fire doors, fans in machinery and accumulator battery spaces, cofferdams, cargo holds and galleys;

.6 main lighting for spaces and locations of essential machinery and equipment, escape routes and emergency lighting;

.7 navigation and flashing lights;

.8 electric engine telegraphs;

.9 service telephone communication;

.10 general alarm system;

.11 fire detection system and warning system indicating the release of fire smothering medium;

.12 watertight and fire doors alarm;

.13 electrical equipment in hazardous spaces and areas;

.14 cable network;

.15 earthing devices on oil tankers;

.16 lightning protection;

.17 electric drives of classed refrigerating plants;

.18 electric fuel oil and lubricating oil heaters;

.19 fixed heating and cooking appliances;

.20 other machinery and devices not listed above as required by the Register.

1.3.2.2 Electrical equipment intended for domestic, living and technological application is subject to technical supervision on board the ship only in relation to:

.1 influence of the operation of this equipment on the performance of the ship's electric generating plant;

.2 selection of types and cross sections of cables and wires, as well as of the ways of cable laying;

.3 resistance of insulation, earthing and protective devices.

1.3.3 Technical supervision during manufacture of electrical equipment.

1.3.3.1 The following kinds of electrical equipment intended for installations and the systems listed in 1.3.2.1 are subject to technical supervision during manufacture:

.1 generating sets;

.2 electric machines;

.3 transformers;

.4 switchboards;

.5 control and monitoring panels;

.6 electric couplings and brakes;

.7 starting, protective, control and switching apparatus;

.8 apparatus and devices of internal communication and signalling;

.9 power static converters, semiconductor installations;

.10 fuel oil and lubricating oil heaters;

.11 accumulator batteries;

.12 cables and wires;

.13 fixed electrical measuring instruments;

.14 electrical instruments and devices for measuring non-electrical quantities;

.15 heating and cooking appliances;

.16 accessories;

.17 fixed lighting fixtures;

.18 control and monitoring devices;

.19 other kinds of electrical equipment not listed above as required by the Register.

1.3.3.2 The safe-type electrical equipment is to be supervised (with respect to its safety) by a special authority which documents are recognized by the Register, irrespective of whether this equipment is subject to the technical supervision according to the requirements of 1.3.3.1 or not.

1.3.3.3 The scope of electrical equipment tests after manufacture is subject to special consideration by the Register and the requirements for the tests are given in Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.4 TECHNICAL DOCUMENTATION

1.4.1 General provisions relating to the procedure of review and approval of technical documentation are given in Part II "Technical Documentation" of Rules for Technical Supervision during Construction of Ships and

Manufacture of Materials and Products for Ships. The scope of technical documentation on electrical equipment to be submitted to the Register for review for the ship as a whole is given in Part I "Classification".

1.4.2 Prior to the beginning of technical supervision of electrical equipment manufacture, the following documentation is to be submitted to the Register for review:

.1 description of operating principle and main characteristics;

.2 specification (list of items) indicating all the components, devices and materials used and their technical characteristics;

.3 general view drawing with sectional views;

.4 circuit diagrams;

.5 tests program;

.6 results of a rotor shaft (armature) calculation; drawings of the fastening of poles, active iron core, commutator, etc., as well as welded joints of a structure and a shaft, for electric machines with a rated current exceeding 1000 A;

.7 busbar calculation for electrodynamic and thermal short-circuit strength — for switchboards if the rated current of separately running generators or total current of parallel running generators exceeds 1000 A;

.8 data on immunity to static or dynamic interference or method of electromagnetic compatibility tests;

.9 measures to be taken for interference suppression.

When necessary, the Register may demand supplementary technical documentation and also data on reliability.

2 GENERAL REQUIREMENTS

2.1 OPERATING CONDITIONS

2.1.1 Influence of climatic conditions.

2.1.1.1 The rated working ambient air and cooling water temperatures for electrical equipment are to be those specified in Table 2.1.1.1.

Table 2.1.1.1

Nos	Location of equipment	Temperature, in °C	
		Ambient air	Cooling water
1	Machinery and boiler spaces, galleys	From –10 up to +40	+25
2	Weather decks	From –20 up to +40	—
3	Other spaces and areas	From –10 up to +40	—

Note. Electronic elements and devices designed for mounting in switchboards, panels or casings are to be capable of reliable operation at the ambient temperature up to 55 °C. The temperature up to 70 °C is not to cause damage to elements, devices and systems.

2.1.1.2 Electrical equipment is to reliably operate under the following conditions:

at a relative air humidity of 80±3 per cent at a temperature of +40±2 °C;

at a relative air humidity of 92±3 per cent at a temperature of +25±2 °C.

2.1.2 Mechanical effects.

2.1.2.1 Electrical equipment is to reliably operate at vibrations with frequencies from 5 Hz to 100 Hz, namely: at frequencies from 5 Hz to 13,2 Hz with an amplitude of displacements of +1 mm and at frequencies from 13,2 Hz to 100 Hz with an acceleration of +0,7*g*. Electrical equipment installed on vibration sources (diesel engines, compressors, etc.) or in the steering gear compartment is to reliably operate at vibrations from 5 Hz to 100 Hz, namely: at frequencies from 5 Hz to 25 Hz with an amplitude of displacements of +1,6 mm and at frequencies from 25 Hz to 100 Hz with an acceleration of +4,0*g*.

2.1.2.2 Electrical equipment is to be capable of reliable operation when the ship has continuous heel up to 15° and trim up to 5°. Emergency equipment is also to reliably operate at continuous heel up to 22,5° and trim up to 10°, as well as at simultaneous heel and trim within the above limits.

2.1.3 Permissible variations of supply parameters.

Electrical equipment is to remain operative under the voltage and frequency variations from the rated values specified in Table 2.1.3.

Table 2.1.3

Characteristics	Variations from rated values		
	for long periods, in per cent	for short periods	
		per cent	s
Voltage	+6 to –10	±20	1,5
Frequency	±5	±10	5

Note. When fed from an accumulator battery:

long-period voltage variation within 30 per cent to 25 per cent for the equipment fed from the accumulator battery connected to charging unit;

long-period voltage variation within 20 per cent to 25 per cent for the equipment which is not connected to the accumulator battery during charging.

The data of Table 2.1.3 are ignored if other values of frequency variations from the rated value are specified in separate Sections of the present Part.

For machinery and devices which are and may operate at the higher values of variations than specified in Table 2.1.3, separate limited networks with such variations are allowed.

2.1.4 For non-essential machinery and devices it is allowed to use the electrical equipment of the general commercial type partly complying with the requirements of 2.2.1 to 2.1.3, which is subject to special consideration by the Register in each case.

2.2 ELECTROMAGNETIC COMPATIBILITY

2.2.1 General.

2.2.1.1 The present requirements apply to electrical and automation equipment, and also to radio and navigational equipment of ships to ensure electromagnetic compatibility on board the ship.

2.2.1.2 Failure-free performance of the equipment is to be ensured under conditions of interference having the following parameters:

.1 constant and variable (50 Hz) magnetic field in accordance with Table 2.2.1.2.1.

Table 2.2.1.2.1

Equipment class	Intensity, in A/m	
	Constant field	Variable field (50 Hz)
1	100	10
2	400	400
3	1000	1000

It is allowed to install the following equipment:

class 1 — at a distance of 2 m and more from a powerful field source (busbar, group transformer);

class 2 — at a distance of 1 m and more from a powerful field source;

class 3 — irrespective of the distance from any field source;

.2 harmonic components of voltage across supply circuits in accordance with the high harmonics diagram for the ship's mains shown in Fig. 2.2.1.2.2 on a logarithmic scale;

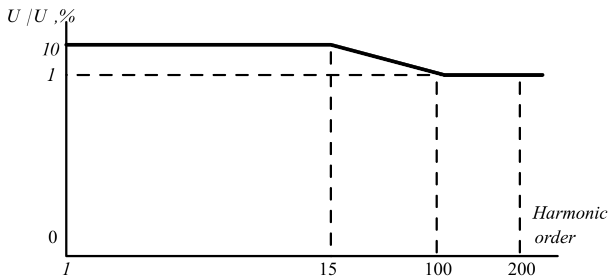


Fig. 2.2.1.2.2 Diagram of high harmonics for the ship's mains

.3 electrostatic discharges with the voltage amplitude of 8 kV;

.4 radio frequency electromagnetic fields within a range of 30 MHz to 500 MHz with a mean-root-square value of field intensity of 10 V/m;

.5 nanosecond voltage pulses with an amplitude of 2 kV for a power supply circuit and of 1 kV for signal and control cables with duration of 5/50 ns;

.6 radio frequency interference across conductivity circuits within a range of 0,01 MHz to 50 MHz with a mean-root-square value of a voltage of 1 V and with 30 per cent modulation at a frequency of 1 MHz;

.7 microsecond voltage pulses across supply circuits with an amplitude of 1 kV for symmetrical pulse feed and of 2 kV for non-symmetrical pulse feed with duration of 1,2/50 µs.

2.2.1.3 The factor of non-linear distortions of the power supply circuit voltage curve is not to exceed 10 per cent and is determined by the following formula:

$$K_u = 1/U_c\sqrt{\Sigma U^2 n \cdot 100\%} \qquad (2.2.1.3)$$

where U_c = actual circuit voltage;
U_n = n-harmonic component voltage;
n = high harmonic order.

The value of K_u is specified for the complete electrical power system of the ship.

On special agreement with the Register, separate busbars with $K_u > 10$ per cent may be used for supply of powerful sources of harmonic components of voltage and of the electrical equipment not sensitive thereto, provided that the above busbars are connected to the main busbars through uncouplers (refer to 2.2.2.2).

2.2.1.4 The voltage level of radio interference from the equipment at supply terminals is not to exceed the values shown in Fig. 2.2.1.4.

2.2.1.5 On ships, where the level of radio interference from power semiconductor converters cannot be limited in accordance with the requirements of 2.2.1.4, the supply network of automation, radio and navigational equipment is to have a galvanic isolation from the supply network of these converters which ensures an attenuation of at least 40 dB within the frequency range of 0,01 MHz to 30 MHz.

The supply cables of the equipment having the levels of radio interference exceeding those specified in 2.2.1.4 are to be laid at least 0,2 m away from the cables of other equipment groups when the common cable run is over 1 m (refer to 2.2.2.8).

2.2.2 Measures ensuring electromagnetic compatibility.

2.2.2.1 In order to protect radio equipment against electromagnetic interference, the requirements of 3.5 and 4.4 of Part XI "Radio Equipment" are to be considered.

2.2.2.2 Rotary converters, special transformers and filters are to be used for the separation of the ship's supply system.

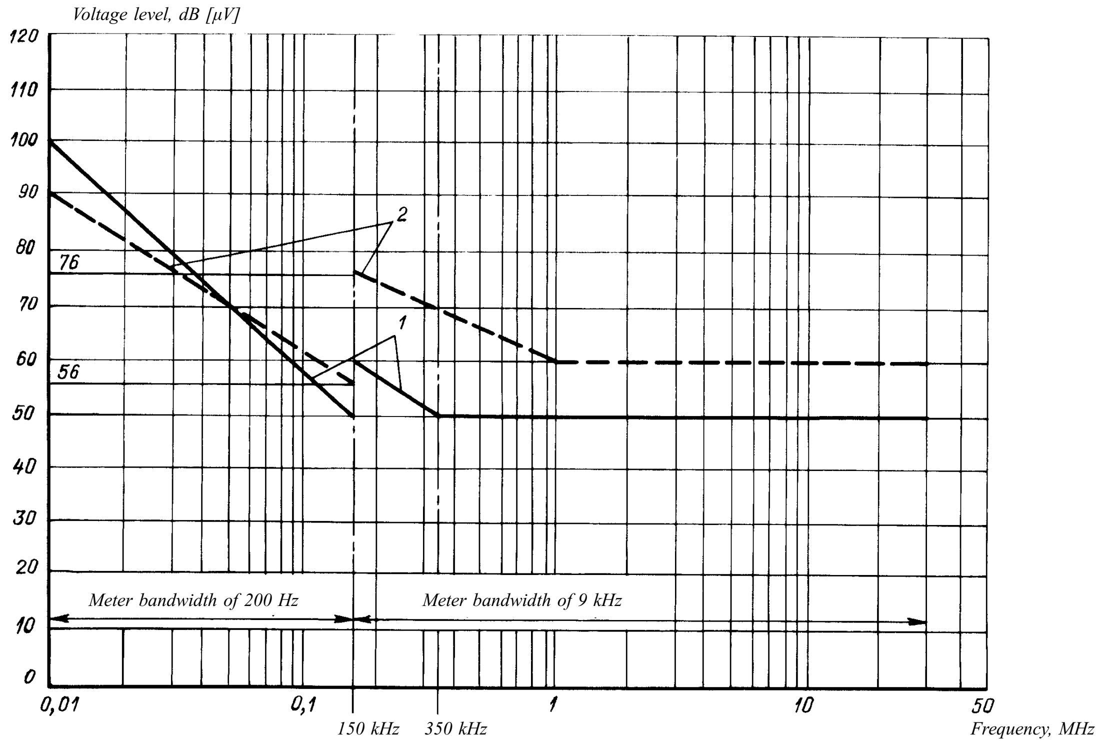


Fig. 2.2.1.4 Permissible levels of radio interference voltage:
1 — due to navigational and radio equipment, as well as due to electrical and automation equipment installed on the wheelhouse deck and higher;
2 — due to equipment installed below the wheelhouse deck

2.2.2.3 The screen of metal armour of power cables are to be connected to the metal casing of the relevant equipment and earthed as frequently as possible, at each end as a minimum.

2.2.2.4 The screens of signal cables are to be earthed at one point on the side of the initial signal processing block. In this case the cable is to have an outer insulating sheathing.

2.2.2.5 Continuous screening is to be ensured, and for this purpose cable screens are to be connected to equipment casings, and it is also to be ensured in cable branch and distributed boxes, and in way of cable penetrations through bulkheads.

2.2.2.6 The earthing fitted to protect against interference is to have an electric resistance not greater than 0,02 ohm, a minimum length possible, be resistant to vibrations and corrosion, and be readily accessible for inspection.

2.2.2.7 Cable screens are not to be used as return conductors.

2.2.2.8 By the type of signal transmitted, the ship's cables are divided as follows:

.1 coaxial cables of radio receivers and video signals with the signal level of 0,1 μV to 500 μV;

.2 screened or coaxial cables transmitting analogue or digital signals with a level of 0,1 V to 115 V;

.3 screened cables of telephone and radio broadcasting apparatus with the signal level of 0,1 V to 115 V;

.4 unscreened below deck and screened on the open deck cables of a power network, control and signalling network with the signal level of 10 V to 1000 V;

.5 coaxial or screened cables of transmitting aerials of radio transmitters, radar installations, an echo sounder, power semiconductor converters with the signal level of 10 V to 1000 V.

2.2.2.9 Cables of the same group may be laid in one cable run provided interference-sensitive equipment is not influenced by the difference in the levels of signals transmitted. Where cable length laid in parallel exceeds 1 m, the cables (cable runs) of different groups are to be laid not less than 0,1 m apart and their crossing is to be effected at a right angle. The radar installation and echo sounder cables specified in 2.2.2.8.5 are either to be double-screened or, if they are coaxial, laid inside a metal pipe. The outer screen is to be earthed along with the principal screen of the cable.

Cables of portable echo sounder transducers are to be double-screened.

The outer screen is to be earthed along with the principal screen of the cable.

2.2.2.10 When electrical equipment is installed and cables are laid close to magnetic compasses, and also in order to protect other navigational equipment against interference, the requirements of Part XII "Navigational Equipment" are to be considered.

2.2.2.11 On all ships constructed from non-conductive materials for which radio equipment is required by the Rules, all the cables within 9 m from aerials are to be shielded or otherwise protected from radio interference, and all the equipment is to be fitted with devices for radio interference suppression (refer to curve 1, Fig. 2.2.1.4).

2.3 MATERIALS

2.3.1 Structural materials.

2.3.1.1 The structural parts of electrical equipment are to be manufactured of durable materials, rated at least as having low flame-spread characteristics, resistant to damp air, oil and fuel oil vapour effects, or reliably protected against such effects.

2.3.1.2 Screws, nuts, hinges and similar items for securing enclosures of the electrical equipment installed on the open deck and in spaces with increased humidity are to be made of corrosion-resistant materials and/or have effective corrosion-resistant coating.

2.3.1.3 All current-carrying parts of electrical equipment are to be made of copper, copper alloys or other materials with equivalent properties except:

.1 rheostat elements which are to be made of mechanically strong materials having high resistivity and capable of withstanding high temperatures;

.2 short-circuit rotor windings of asynchronous and synchronous motors which may be made of aluminium or its alloys;

.3 carbon brushes, cermet contact and other similar parts when the properties specified so require;

.4 parts of electrical equipment directly connected to the ship's hull used as a return conductor with a singlewire system.

The use of other materials for current-carrying parts is subject to special consideration by the Register in each case.

2.3.2 Insulating materials.

2.3.2.1 Insulating materials of live parts are to have adequate dielectric strength and resistance to creepage currents, moister and oil, as well as sufficient mechanical strength, or be suitably protected.

The heating temperature of current-carrying parts and their connections is not to exceed the permissible heating temperature of the insulating materials at a rated load.

2.3.2.2 Non-flammable liquids may be used for cooling uninsulated parts of electrical equipment.

The use of flammable oils for this purpose is subject to special consideration by the Register in each case.

2.3.2.3 The insulating materials used for winding insulation in machines, apparatus and other equipment for essential services are to comply with agreed standards.

The use of insulating materials not lower than Class E is recommended.

2.3.2.4 Conductors used in electrical devices for internal connections are to have insulation made of materials rated at least as having low flame-spread characteristics, and for apparatus with increased heating, as well as specified in Section 15, of non-combustible materials.

2.3.2.5 Insulating materials used for manufacture of cables are specified in 16.3.

2.4 STRUCTURAL REQUIREMENTS AND PROTECTION OF ELECTRICAL EQUIPMENT

2.4.1 General.

2.4.1.1 The parts to be replaced in service are to be readily dismountable.

2.4.1.2 Where screw fastenings are used, provision is to be made for prevention screws and nuts self-loosening and their loss in areas of frequent dismantling and opening.

2.4.1.3 Sealing gaskets of electrical equipment parts (doors, covers, holes, glands, etc.) are to ensure adequate protection while in service. Gaskets are to be secured to a cover or casing.

2.4.1.4 Where casings, panels and covers of electrical equipment located in areas accessible to unspecialized personnel prevent access to live parts, they are to be opened with tools only.

2.4.1.5 Proper water drainage arrangements are to be provided in electrical equipment where condensation is likely to occur. Channels are to be provided inside the equipment to ensure condensate drainage from all the equipment components. Windings and live parts are to be so arranged or protected that they are not exposed to the effects of the condensate which may accumulate inside the equipment.

2.4.1.6 Electrical equipment with forced ventilation designed for installation in lower parts of damp spaces is to be provided with a ventilation system so as to prevent, as far as possible, suction of moisture and oil vapours inside the equipment.

2.4.1.7 Where measuring instruments with oil, steam or water supply are fitted in the control panel or desk, measures are to be taken to prevent these agents from making contact with live parts in case of damage to the instruments or pipelines.

2.4.2 Insulation clearances.

Clearances between live parts at different potentials, or between live parts and metal parts or another enclosure, both in air and across the insulant surface, are to be in conformity with an operating voltage and operating conditions of the installation with due regard for the properties of insulating materials used.

2.4.3 Internal wiring.

2.4.3.1 Standard wires are to be used for internal wiring of electrical equipment throughout. The use of solid wires is subject to special consideration by the Register in each case.

2.4.3.2 For internal wiring of switchgear, control panels and other distributing and switching devices, etc., the wires of a cross-sectional area of at least 0,75 mm^2 are to be used.

For systems of control, protection, measurement of various parameters, signaling and internal communication, the use of wires having a cross-sectional area of not less than 0,5 mm^2 is allowed.

For electronic and electrical devices for transformation and transmission of low-power signals, the wires of a cross-sectional area of less than 0,5 mm^2 may be used subject to special consideration by the Register in each case.

The wires having a cross-sectional stand area over 50 mm^2 may be used for wiring from protection devices (circuit breakers, fuses) up to outlet terminals. Uninsulated wires from busbars up to protection devices are to be as short as possible and not longer than 1 m.

2.4.3.3 Current-carrying parts are to be secured in a way preventing any additional mechanical load on them; in so doing, screws directly fitted in an insulating material are not allowed.

2.4.3.4 The ends of stranded cable and wire conductors are to be finished depending on the type of a terminal used or to have cable lugs.

2.4.3.5 Insulated wires are to be laid and secured in such a manner that the method used for their securing and arrangement does not lead to reduced insulation resistance and that they are not exposed to damage due to electrodynamic loads, vibrations and shocks.

2.4.3.6 Measures are to be taken to prevent temperature rise above the level permissible for insulated wires in normal service conditions or for the duration of short-circuit current breaking.

2.4.3.7 Insulated wires connection to terminals and busbars is to be so effected that the wire insulation is not exposed to an overheating temperature under the rated service conditions.

2.4.4 Protection of electrical equipment.

2.4.4.1 Depending on location, the use is to be made of electrical equipment in appropriate protective enclosure, or other suitable measures are to be taken to protect the equipment from harmful effects of the environment and the personnel from electric shock hazards.

2.4.4.2 The minimal protection of electrical equipment located in the ship's spaces and areas is to be determined according to Table 2.4.4.2.

Table 2.4.4.2

Location of electrical equipment	Type of electrical equipment							
	Generators	Motors	Transformers	Switchgear	Switching devices	Communication and signalling equipment, wiring accessories	Space heating and cooking appliances	Lighting fixtures
Spaces and zones in which explosive mixtures of vapours, gases and dust with air are likely to occur		Ex				Ex		Ex
Dry spaces, dry accommodation spaces			IP20	IP20	IP20	IP20	IP20	IP20
Navigating bridge, radio room			IP22	IP22[1]	IP22	IP22	IP22	IP22
Service spaces, steering gear room, (except for ammonia equipment) emergency generator room, general purpose stores, pantries, provision stores	IP22	IP22	IP22	IP22[1]	IP22	IP22	IP22	IP22
Engine and boiler rooms								
Above plating	IP22	IP22	IP22	IP22[1]	IP22	IP44	IP22	IP22
Below plating	IP44	IP44	IP44			IP44	IP44	IP44
Control stations (dry)	IP22	IP22	IP22	IP22[1]	IP22	IP22	IP22	IP22
Enclosed operator rooms		IP44	IP44	IP44	IP44	IP44	IP44	IP44
Refrigerated spaces, galleys, laundries, bathrooms and showers		IP44		IP44	IP44	IP55	IP44	IP44
Cargo holds		IP55		IP55	IP55	IP55		IP55
Open decks		IP55[2]		IP55[2]	IP55[2]	IP55[2]		IP55[2]

[1] For main and emergency switchboards and also for control consoles an enclosure of IP21 type may be specified.

[2] IP56 for appliances which may be flooded with water.

Note. Where the enclosure of equipment does not ensure the necessary protection, alternative methods or alternative arrangement of equipment are to be applied to ensure the degree of protection required.

2.5 PROTECTIVE EARTHING OF METAL PARTS WHICH DO NOT CARRY CURRENT

Metal enclosures of electrical equipment operating at a voltage above the safety level and having no double of reinforced insulation are to be fitted with an earth terminal marked with the symbol "⊥".

Provision is to be made for earthing inside or outside the electrical equipment enclosure depending on its purpose.

2.5.1 Parts to be earthed.

2.5.1.1 Metal parts of electrical equipment which are likely to be touched under service conditions and which may become live in the event of insulation damage (except for those specified in 2.5.1.2) are to have a reliable electric contact with the part fitted with an earth terminal (refer also to 2.5.3).

2.5.1.2 Protective earthing is not required for the following types of equipment:

.1 electrical equipment fed with the safety voltage current;

.2 electrical equipment provided with double or reinforced insulation;

.3 metal parts of electrical equipment fastened in an insulating material or passing through and isolated from live parts in such a manner that under normal operating conditions these parts cannot become live or come in contact with earthed parts;

.4 housings of specially insulated bearings;

.5 lamp caps and fastenings for luminescent lamps, lampshades, reflectors and guards supported on lamp holders of lighting fixtures made of or screwed in an insulating material;

.6 cable fastenings;

.7 individual consumer with a voltage up to 250 V supplied through an insulating transformer.

2.5.1.3 Shields and metal armour of cables are to be earthed.

2.5.1.4 The secondary windings of all instrument current and voltage transformers are to be earthed.

2.5.2 Earthing of aluminium structures on steel ships.

Superstructures of aluminium alloys fastened to the ship's steel hull, but insulated therefrom, are to be earthed with at least two special wires, each having a cross-sectional area not less than 16 mm^2, that will not initiate electrolytic corrosion at the points of their contact with the superstructure and hull. Such earthing connections are to be provided at different locations around superstructure perimeter, be accessible for inspection and protected from damage.

2.5.3 Earthing terminals and conductors.

2.5.3.1 Bolts for fastening the earthing conductor to the ship's hull are to have a diameter not less than 6 mm. For wires having a cross-sectional area up to 2,5 mm^2 and up to 4 mm^2 it is allowed to use bolts 4 mm and 5 mm in diameter respectively. These bolts are not to be used for purposes other than earthing conductors fastening.

The ship's hull in places of earthing conductor connections is to be cleaned to metal and properly protected against corrosion.

2.5.3.2 Fixed electrical equipment is to be earthed by means of external earthing conductors or a core in the feeding cable.

When earthing is effected with one of the cores of the feeding cable, it is to be connected to the earthed part of equipment inside its enclosure.

Special earthing effected with external earthing conductors may be omitted where the arrangement of equipment ensures a reliable electrical contact between the equipment enclosure and the ship's hull under all operating conditions.

For earthing effected with an external earthing conductors the use is to be made of copper conductors, as well as of conductors of any other corrosion-resistant metal provided the resistance of these conductors does not exceed that of the copper conductor required. The cross-sectional area of the earthing copper conductor is to be not less than that specified in Table 2.5.3.2.

Table 2.5.3.2

Cross-sectional area of the feeding cable core, in mm^2	Cross-sectional area of the earthing conductor	
	Earthing core in the feeding cable, in mm^2	External earthing conductor, in mm^2
0,5 up to 4	Equal to cross-sectional area of the feeding cable core	4
Over 4 up to 16	Equal to cross-sectional area of the feeding cable core	Equal to cross-sectional area of the feeding cable core
Over 16 up to 35	16	Equal to cross-sectional area of the feeding cable core
Over 35 up to 120	Half the cross-sectional area of the feeding cable core	Half the cross-sectional area of the feeding cable core
120 and over	70	Half the cross-sectional area of the feeding cable core

For earthing effected with the special core of a feeding cable the cross-sectional area of this core is to be equal to the nominal cross-sectional area of the feeding cable core for cables having a cross-sectional area up to 16 mm^2 and at least half the cross-sectional area of the feeding cable core, but not less than 16 mm^2, for cables giving a cross-sectional area over 16 mm^2.

2.5.3.3 Earthing of movable, detachable and portable consumers is to be effected through an earthed jack in a socket outlet or another earthed contact device and the copper earthing core of a flexible feeding cable. The cross-sectional area of the earthing core is to be not less than the nominal cross-sectional area of the flexible feeding cable core for cables up to 16 mm^2 and at least half the cross-sectional area of the feeding flexible cable core, but not less than 16 mm^2, for cables over 16 mm^2.

2.5.3.4 Conductors and cores used for equipment earthing are to be non-disconnectable.

2.5.3.5 Earthing of shields and metal armour of cables is to be effected in one of the following ways:

.1 using a copper earthing wire of a cross-sectional area not less than 1,5 mm^2 for cables with a cross-sectional area up to 25 mm^2 and not less than 4 mm^2 for cables with a cross-sectional area over 25 mm^2;

.2 by adequate attachment of shields and metal armour to the hull;

.3 by means of cable gland rings provided they are characterized by corrosion resistance, good conductivity and elasticity.

Except for cables of end branches of circuits which may be earthed at the supply end only, earthing is to be effected at both cable ends. Cable shields and metal armour may be earthed in another approved way provided these methods do not interfere the operation of equipment.

2.5.3.6 External earthing conductors are to be accessible for inspection and protected against loosening and mechanical damage.

2.5.3.7 Earthing of electrical equipment by connection to pipelines, tanks and cylinders for compressed gases and oil products is forbidden.

2.5.3.8 Earthing of electrical equipment installed in hazardous spaces and zones is to be effected with an external earthing conductor irrespective of the way this equipment is secured.

2.6 LIGHTNING PROTECTION

2.6.1 General.

2.6.1.1 Ships are to be provided with lightning protection devices with protected zone covering all the equipment requiring lightning protection.

On ships, where consequential effects of lightning strokes may result in fires and explosions, lightning protection earthing devices are to be fitted to prevent the possibility of consequential sparking.

2.6.1.2 A lightning protection device is to comprise an air termination, down protection device and earth termination. On metal masts, lightning protection devices may be omitted where provision is made for a reliable electrical connection of the mast to the ship's metal hull or earthing point.

2.6.2 Air termination network.

2.6.2.1 On metal ships, their vertically extended structures like masts, derrick posts, superstructures, etc. may be used as air terminations where provision is made for the reliable electrical connection of those structures to the metal hull of the ship.

Additional air terminations are to be used only when the ship's structural elements do not provide for reliable thunderstorm protection.

2.6.2.2 Where electrical equipment is installed on the top of a metal mast, provision is to be made for an air termination network, which is effectively earthed.

2.6.2.3 On each mast or topmast made of a non-conducting material an effectively earthed lightning conductor is to be fitted.

2.6.2.4 The air termination is to be made of a rod of at least 12 mm in diameter. The rod may be of copper, copper alloys or steel protected against corrosion. Aluminium air terminations are to be used for aluminium masts.

2.6.2.5 The air termination is to be fitted to the mast in such a manner that it projects at least 300 mm above the top of the mast or above any device fitted on its top.

2.6.3 Down conductor.

2.6.3.1 The down conductor is to be made of a rod, strip or multiwire cable having a cross-sectional area not less than 70 mm^2 for copper or its alloys, and not less than 100 mm^2 for steel. Steel down conductors are to be protected against corrosion.

2.6.3.2 Down conductors are to run on the outer side of masts and superstructures with the minimum number of bends, which are to be fair and have as large radius as possible.

2.6.3.3 Down conductors are not to run through hazardous spaces and zones.

2.6.3.4 On ships with non-metal hull the down conductor of the lightning protection device is to be laid separately throughout its length (including its connection to the earth termination network) without connecting to the busbars of the protective and operation earthing.

2.6.4 Earth termination network.

2.6.4.1 On composite ships the metal stem or other metal structures immersed in water under any navigation conditions may be used as earth termination.

2.6.4.2 Means are to be provided on board the ship to allow for connecting the ship's steel hull or earth termination network to the shore-based earth termination network while the ship is in a dock or on a slipway.

2.6.4.3 Earthing of ships with nonconducting hulls is to be effected according to 1.2.1 (refer to the definition of "Ship's hull").

2.6.5 Connections in lightning protection device.

2.6.5.1 Connections between the air termination network, down conductor and earth termination network are to be welded or bolted with clamps.

2.6.5.2 The contacting surface area between the down conductor and air termination network or earth termination network is to be not less than 1000 mm^2.

Connecting clamps and bolts are to be made of copper, copper alloys or steel protected against corrosion.

2.6.6 Lightning protection earthing devices.

2.6.6.1 Lightning protection earthing is to be provided for isolated metal structures, movable connections, pipelines, screens of electrical networks and communication lines, entries into hazardous spaces.

2.6.6.2 Oily products pipelines, as well as all other pipelines connected with hazardous spaces and located on the open parts of a deck or in spaces free from electromagnetic screening are to be earthed to the ship's hull no more than in 10 m intervals throughout their length.

The pipelines located on the deck where explosive gases are likely to occur, and which are not connected with hazardous spaces are to be earthed to the ship's hull no more than in 30 m intervals throughout their length.

2.6.6.3 Metal parts near down conductors are to be earthed if they are not fixed to earthed structures or have no other metal connection to the ship's hull. Facilities or metal parts located at a distance up to 200 mm from down conductors are to be connected to the down conductor so as to prevent potential consequential sparking.

2.6.6.4 All the joints of earthing elements are to be accessible for inspection and protected against mechanical damages.

2.7 ARRANGEMENT OF ELECTRICAL EQUIPMENT

2.7.1 Electrical equipment is to be so installed that easy access to controls and to all parts requiring maintenance, inspection and replacement is ensured.

2.7.2 Air-cooled electrical equipment is to be so located that cooling air intake is not carried out from bilges or other spaces wherein the air may be contaminated with substances having a harmful effect on insulation.

2.7.3 Electrical equipment installed in locations subject to vibration and shocks (heavier than that specified in 2.1.1.1), which are impossible to be eliminated, is to be so designed as to ensure its normal operation under these conditions or to be mounted on the relevant shock absorbers.

2.7.4 Electrical equipment is to be fixed in such a manner that the strength and tightness of decks, bulkheads and hull plating is not impaired.

2.7.5 Open live parts of electrical equipment are not to be located closer than 300 mm horizontally and 1200 mm vertically to non-protected combustible materials.

2.7.6 The open live parts of electrical equipment enclosures are made of different materials than the structures on which they are installed, measures are to be taken to prevent electrolytic corrosion if necessary.

2.8 SPECIAL ELECTRICAL SPACES

2.8.1 The doors of special electrical spaces are to be locked and are to open on the outside.

Where the doors face corridors and passageways in accommodation and service spaces, they may open on the inside provided guards and stops are fitted. A warning notice is to be fixed to the door. The door is to open without a key from the inside of the space.

2.8.2 Special electrical spaces are not to be adjacent to flammable liquid tanks. If this requirement is structurally unrealizable, measures are to be taken preventing the possibility of flammable liquid penetration into these spaces.

2.8.3 No exits, side scuttles of the opening type or other openings are allowed from special electrical spaces into hazardous spaces and zones.

2.8.4 Handrails of insulating material are to be fitted in special electrical spaces, in passageways and servicing areas where the open-type electrical equipment is installed.

2.9 SAFE-TYPE ELECTRICAL EQUIPMENT

2.9.1 The requirements of the present Chapter apply to the equipment which is installed on ships, enclosed and semi-enclosed spaces and locations in which explosive mixtures of vapours, gases and dust with air are likely to occur.

The following spaces and zones fall under this category: paint stores, lamp lockers (for oil lanterns), accumulator battery rooms and spaces which contain tanks, machinery and pipelines for flammable liquids having a flash point 55 °C and below, as well as cargo holds provided for the carriage of dangerous goods.

Additional requirements for installation of electrical equipment on oil tankers are specified in 19.2, and the requirements for installation of electrical equipment on ships with holds and other spaces for the carriage of vehicles with fuel in their tanks, tank-wagons, and tank-cars for flammable liquids are specified in 19.3.

2.9.2 In hazardous spaces and zones only safe-type electrical equipment may be installed, the protection of which complies with the category and group of the most dangerous gas mixture.

Such electrical equipment is to be of the following safe type: intrinsically safe *Exi*, pressurized enclosure *Exp*, flameproof *Exd*, increased safety *Exe* (refer to 1.3.3.2).

2.9.3 In spaces where explosive mixtures of dust or fibre with air may occur, the electrical equipment with the degree of protection not below IP65 type is to be installed.

If the occurrence of the flammable dust-and-fibre mixture is temporary resulting from the damage or leakage from processing equipment in operation or ventilation cutoff, electrical equipment with the degree of protection IP55 may be installed.

Electrical equipment installed in such spaces is to have such protective coating that the temperature of its upper horizontal surfaces or those inclined more than 60° to the horizontal is, under conditions of continuous operation, by 75 °C below the smouldering point of the dust accumulated in the given space (the smouldering point is to be determined for a dust layer 5 mm thick).

2.9.4 Lighting fixtures of the safe type are to be so fitted that a free space around them is not to be less than 100 mm except the fastening place.

2.9.5 Any equipment installed in hazardous spaces and zones except fire detectors are to be provided with a switch fitted in a safe place outside hazardous spaces and zones to disconnect life conductors.

2.9.6 Fastening of electrical equipment directly to the walls of flammable liquid tanks is not allowed. In all cases electrical equipment is to be fastened at a distance not less than 75 mm from tank walls.

2.9.7 In hazardous spaces and zones only the cables for the electrical equipment installed in these spaces and zones may be laid. The through runs of cables may be allowed in the above spaces and zones provided the requirements of 2.9.8 to 2.9.12 are met.

2.9.8 Cables laid in hazardous spaces and zones are to have:

.1 metal armour or braid with an additional non-metal covering;

.2 lead sheathing with additional mechanical protection;

.3 copper or stainless steel sheathing (for cables with mineral insulation only).

2.9.9 Cables passing through hazardous spaces and zones are to be protected against mechanical damages.

2.9.10 All shields, as well as metal braids of the cables of power circuits for electric motors and lighting circuits which pass through hazardous spaces and zones or supply the electrical equipment installed in these spaces are to be earthed at both ends at least.

2.9.11 Cables of intrinsically safe circuits may be used for one device only and are to be laid separately from other cables.

2.9.12 Cables of portable electrical equipment except for the cables of intrinsically safe circuits are not to pass through hazardous spaces and zones.

2.9.13 Additional requirements for electrical equipment installed in paint stores.

2.9.13.1 In paint stores and their ventilation ducts it is allowed to install only such electrical equipment which is necessary for servicing these spaces. Such electrical equipment is to be of the safe type: intrinsically safe *Exi*, pressurized *Exp*, flameproof *Exd*, increased safety *Exe*, or to have special protection *Exs*.

2.9.13.2 The minimum requirements for the safe type equipment are as follows: explosion group IIB, temperature class T3.

2.9.13.3 In paint stores and spaces specified in 2.9.13.4 cables (through-runs or terminating cables) of armoured type or installed in metal conduits are to be used.

2.9.13.4 In locations on the open deck within 1 m of supply and exhaust ventilation openings or within 3 m of exhaust mechanical ventilation outlets, the following electrical equipment may be installed: safe type equipment according to 2.9.13.1, equipment of protection class *Exn*, equipment which does not generate arcs or sparks in service and which surface does not reach unacceptably high temperatures under normal operating conditions.

2.9.13.5 Enclosed spaces giving access to paint stores may be considered as non-hazardous provided that:

.1 the door to the paint store is gastight with self-closing devices and has no holding-back arrangements;

.2 paint stores are provided with an independent natural ventilation system with an air intake from places outside hazardous spaces;

.3 warning notices are fitted at the entrance stating the presence of flammable liquids in the store.

3 MAIN SOURCE OF ELECTRICAL POWER

3.1 COMPOSITION AND CAPACITY OF THE MAIN SOURCE OF ELECTRICAL POWER

3.1.1 Every ship is to be provided with the main source of electrical power with a capacity sufficient to supply all the electrical equipment on board the ship necessary under conditions specified in 3.1.5. Such a source is to consist at least of two independently driven generators.

3.1.2 The number and capacity of independently driven generators and electric transducers being part of the main source of electrical power are to be such that if any of them failed the rest ensure:

.1 supply to electrical equipment necessary under conditions specified in 3.1.5 and normal habitable conditions on board the ship;

.2 start of the most powerful electric motor with the greatest starting current. The motor start therewith is not to cause such voltage and frequency reduction in the mains which can result in falling out of synchronism, the stop of a generator engine, as well as the disconnection of running machinery and apparatus;

.3 supply to consumers necessary for starting the propulsion plant when the ship is de-energized. For this purpose the emergency source of electrical power may be used if its capacity proper or in association with the capacity of any other source of electrical power ensures simultaneous supply of consumers, specified in 9.3.1 or 19.1.3.1, for the purpose of which their parallel operation may be provided.

3.1.3 Where the main source of electrical power is necessary to ensure the ship's propulsion, control and safety, provision is to be made for continuous or immediately restorable (if any running generator fails) supply of the equipment essential for the above purposes.

On ships, where normal supply of electrical power is provided with one generator, provision is to be made for the automatic start of a stand-by generator of sufficient capacity and its connection to the main switchboard busbars within 30 s when the generator fails and the main switchboard is deenergized.

3.1.4 Instead of one of independently driven generators specified in 3.1.1 a main engine-driven generator (shaft generator) may be used if it meets the requirements of 3.2.6 under the following conditions:

.1 the shaft generator operates at the ship's various rates of speed with the rotation speed at which the network frequency is within the limits specified in Table 2.1.3.1;

.2 provision is made for actuation of the ship's propulsion plant when any independently driven generator fails.

The use of shaft generators operating at different speeds of main engines or shafts and being part of the main source of electrical power is subject to special consideration by the Register.

3.1.5 The number and power output of generators forming the main source of electrical power are to be determined with due regard for the following operating conditions of the ship:

.1 running conditions;

.2 manoeuvring;

.3 in case of fire, the hole in the ship's hull or other conditions affecting safety of the ship's navigation, with the main source of electrical power in operation;

.4 other operating conditions according to the ship's purpose.

3.1.6 Where accumulator batteries are the main source of electrical power, their capacity is to be sufficient to meet the requirements of 3.1.2.1 during 3 hours without recharging, and provision is to be made for the possibility of their charging from the source of electrical power installed on board the ship.

3.2 ELECTRIC MACHINE SETS

3.2.1 The engines designed for use as generator prime moves are to meet the requirements of Part VIII "Machinery" and the additional requirements of the present Chapter.

3.2.2 The voltage of independently driven generators is to be regulated within the limits specified in 10.6 and 10.7, and their frequency, within the limits specified in 2.11.3, Part VIII "Machinery".

3.2.3 The deviation from sine voltage for alternators is not to be more than 5 per cent the first harmonic peak value.

3.2.4 The alternators intended for parallel operation are to be provided with such a reactive voltage drop compensation system that the reactive load sharing between the generators during the parallel operation does not differ from a valve proportional to their output by more than 10 per cent of the rated reactive load of the largest generator or by not more than 25 per cent of the rated output of the smallest generator if this valve is less than the above one.

3.2.5 When alternators run in parallel loaded at 20 per cent to 100 per cent of the total output, load sharing between them is to be within +15 per cent of the active power.

3.2.6 The generators used for supply of the ship's mains are to be fitted with devices regulating a voltage within the limits specified in 10.6 and 10.7, and a frequency, within the limits specified in 2.11.3 of Part VIII "Machinery".

With mains frequency reduction below a permissible level, provision is to be made for an automatic connection of independently driven generators or an accumulator battery to the ship's mains or an alarm is be activated at a watch keeping station.

3.2.7 When a shaft generator is connected to the ship's mains, a visual warning signal (white steady signal according to Table 4.6.5) is to be activated at the navigating bridge indicating that a change in the main machinery operation mode may result in the deviation of the ship's mains parameters beyond the limits specified in 10.6 and 10.7, and also in 2.11.3, Part VIII "Machinery".

3.2.8 On agreement with the Register, other speed and regulating characteristics for generators having power up to 10 kW (kVA) may me allowed provided the uninterruptible operation of an entire installation is ensured.

3.2.9 No-voltage of an accumulator battery is not to result in the damage of the generator and its voltage regulator when the accumulator battery floats on the generator.

3.3 NUMBER AND CAPACITY OF TRANSFORMERS

3.3.1 On ships where lighting and other essential services are fed through transformers, provision is to be made for at least two transformers of such a capacity that in case of failure of the largest one the remaining transformers are capable to fully supply electrical power under all operating conditions of the ship. Where a sectional system of busbars is used, transformers are to be connected to different sections. On ships (except passenger ships) with the electrical installation of low power, on a special agreement with the Register, depending on the specific area of navigation, only one transformer may be provided.

3.4 POWER SUPPLY FROM THE EXTERNAL SOURCE OF ELECTRICAL POWER

3.4.1 Where provision is made for the ship's mains to be supplied from the external source of electrical power, an external supply switchboard is to be installed on the ship.

3.4.2 The external source of electrical power is to be provided with the following:

.1 terminals for flexible cable connections;

.2 switchgear and protective devices for connection and protection of the permanently laid cable of the main switchboard; where the cable length between the external supply switchboard and the main switchboard is under 10 m, protective devices may be omitted;

.3 voltmeter or pilot lamps indicating the presence of a voltage from an external source across the terminals;

.4 device or a possibility of connecting a device to control polarity or phase sequence; it is recommended to provide a phase switch;

.5 terminal for earthing a neutral wire from an external source;

.6 plate indicating a voltage, the type of current and frequency;

.7 arrangement for securing the end of a flexible cable connected to the switchboard and staples for cable suspension which are to be placed at the external supply switchboard or near it.

3.4.3 The external supply switchboard is to be connected to the main switchboard with a permanently laid cable.

3.4.4 On ships with the electrical installation of low power it is allowed to connect supply from the external source of electrical power with plug devices. The plug device with a rated current over 16 A is to have an interlock switch preventing the possibility of plug and socket disconnection or connection while the switch is the "ON" position.

The design of plug connections is to prevent their spontaneous disconnection.

3.4.5 Provision is to be made for the ship's hull earthing when the supply from the external source of electrical power has a voltage over 50 V. The earthing point is to be marked. In direct-current installations using the ship's hull as a return conductor the negative pole of supply from the external source of electrical power is to be connected to the hull.

3.5 TRANSMISSION OF ELECTRICAL POWER TO WATERCRAFT OR SHORE

3.5.1 If provision is made for transmission of electrical power to other watercraft (e.g. to pushed barges), the supplying ship is to be fitted with a switchboard for flexible cable connection.

The feeder for switchboard supply is to be provided with protective and switching devices. The transmission of electrical power to watercraft is to be carried out on the isolated system of distribution. At a voltage over 50 V and/or transmission of a current over 16 A, connection of a portable flexible cable is to be possible in deenergized condition only.

Hulls of ships are to be electrically connected to one another in places specially provided for that purpose.

3.5.2 In addition to the requirements of 3.5.1 the following is to be provided for supply of pushed barges:

.1 cables and socket outlets are to be designed for a current not less than 16 A and not more than 63 A. Joints during supply transmission are to be effected with flexible cable jumpers which are free to sag;

.2 the possibility of emergency disconnection of supply on the pushed barge is to be ensured;

.3 the relevant plug connections and/or distributing gear are to be fitted in the fore and aft parts of the pushed barge;

.4 disconnection of pushed barges electrical equipment supply is to be provided through a multipolar switch controlled from the wheelhouse;

.5 multipolar plug connections and multicore cables may be used for supply of several consumers.

3.6 CONNECTION OF ELECTRICAL POWER SUPPLY UNITS

3.6.1 Where electrical power supply units are not adapted for a prolonged parallel operation on common busbars, a connection circuit ensuring their switching-on for parallel operation during load transfer from one unit to another is to be applied.

3.6.2 Direct-current compound generators designed for parallel operation are to have equalizing connections.

3.6.3 Where alternating-current generators are intended to operate in parallel, a synchronizer is to be fitted on the main switchboard. Where synchronizing is arranged to operate automatically, a standby manual synchronizer is to be provided.

3.6.4 Where several direct-current generators are installed, a device for excitation is to be fitted on the main switchboard. Such a device may also be allowed for synchronous alternating-current generators if it is necessary for initial excitation.

3.6.5 Where the ship's and external sources of electrical power are not intended to operate in parallel on the common busbars of the ship's electrical installation, the system of connections is to be so interlocked in this case as to prevent their possible switching-on for parallel operation.

4 DISTRIBUTION OF ELECTRICAL POWER

4.1 DISTRIBUTION SYSTEMS

4.1.1 The use of the following systems of electrical power distribution is allowed in the ship's installations.

4.1.1.1 For direct current and single-phase alternating current:

.1 two-conductor system insulated from the ship's hull;

.2 two-conductor system with one earthed wire provided that any potential current does not traverse directly through any of hazardous spaces and zones;

.3 single-conductor system using the hull-return principle, only for local installations (for example, starting gear for combustion engines, cathodic protection) provided that any potential current does not traverse directly through any of hazardous spaces and zones.

4.1.1.2 For three-phase alternating current:

.1 four-conductor system with earthing of the neutral point, not using the hull-return principle;

.2 three-conductor system insulated from the ship's hull;

.3 three-conductor system with earthing of the neutral point, using the hull-return principle except for terminal circuits.

The use of other distribution systems is, in each case, subject to special consideration by the Register.

4.2 PERMISSIBLE VOLTAGE

4.2.1 Permissible voltage across the terminals of electrical power sources is not to exceed the following values:

500 V for power systems;

50 V for lighting and heating systems, and socket outlets.

It is recommended to use standard values of voltage and frequencies. The rated voltage of generators may exceed that of consumers by 5 per cent.

4.2.2 Permissible voltage across the terminals of consumers is not to exceed the values specified in Table 4.2.2.

Table 4.2.2

Nos	Consumers	Permissible voltage	
		Direct and single-phase alternating current	Three-phase alternating current
1	Fixed power consumers	250	500
2	Fixed heating and cooking appliances	250	500
3	Portable power consumers fixed when used and fed from plug sockets	250	500
4	Lighting, alarm systems and internal communication	250	250
5	Socket outlets for supply of portable consumers with double or reinforced insulation or electrically-isolated with an isolating transformer	250	250
6	Socket outlets fitted in locations and spaces with increased humidity, and also in extra humid spaces, and intended for supply of consumers having no double or reinforced insulation or not isolated electrically	50	50

4.3 POWER SUPPLY OF ESSENTIAL SERVICES

4.3.1 The following consumers are to be supplied from the main switchboard busbars by separate feeders:

.1 electric drives of steering gear (refer also to 5.5.2);

.2 electric drives of anchor gear;

.3 electric drives of fire pumps;

.4 electric drives of bilge pumps;

.5 electric drives of sprinkler system compressors and pumps;

.6 gyrocompass;

.7 refrigerating plant switchboard for cargo holds;

.8 electric drives of electrical propulsion plant exciter sets;

.9 section switchboards of the main lighting;

.10 radio station switchboard;

.11 navigation equipment switchboard;

.12 navigation lights switchboard;

.13 section switchboards and distributing gear for supply of other essential services combined on the principle of similarity of their functions;

.14 distributing gear of integrated bridge control panel (refer also to 4.5);

.15 switchboard of automatic fire detection station;

.16 electric drives of auxiliaries ensuring the operation of the main machinery;

.17 switchboards of electric drives for cargo, mooring, boat and other gear, ventilation and heating appliances;

.18 control devices of controllable pitch propeller;

.19 charging facilities of starter accumulator batteries and batteries supplying essential services;

.20 supply switchboards for electric drives for closure of watertight doors and for devices holding fire doors in open position, as well as signal panels of watertight and fire doors position and closure;

.21 switchboard of refrigerating plant for a low pressure carbon dioxide extinguishing system;

.22 other services not listed above as required by the Register.

It is allowed to supply services listed in items 4, 6, 10, 11, 12, 15, 16, 18, 19 and 20 from the switchgear specified in items 13 or 14 by separate feeders provided with switching and protective devices.

4.3.2 Where the machinery with the same functions and electric drives specified in 4.3.1 is installed in double or greater number, except those required by 4.3.1.1, 4.3.1.5 and 4.3.1.8, at least one of these electric drives is to be fed from the main switchboard by a separate feeder. Electric drives of the rest of such machinery may be supplied from section switchboards or special distribution devices intended for supply of essential services.

If the main switchboard busbars are subdivided into sections having intersectional disconnecting devices, electric drives, section switchboards, special distributing devices or boards installed in double or greater number, or supplied by two feeders are to be connected to the different sections of the main switchboard.

4.3.3 End branches of circuits having a rated current over 16 A are to supply not more than one consumer.

4.4 POWER SUPPLY OF ELECTRICAL (ELECTRONIC) AUTOMATION SYSTEMS

4.4.1 The supply of electrical (electronic) automation systems is to meet the requirements of Part X "Automation".

4.4.2 The supply of automation devices necessary for starting and operating the emergency diesel generator is to be effected from a starter or another separate accumulator battery located in the emergency diesel generator room.

4.5 POWER SUPPLY OF INTEGRATED BRIDGE CONTROL CONSOLE

4.5.1 The electrical, navigational and radio equipment, electrical automation and remote-control devices for the main and auxiliary machinery arranged in the integrated bridge control console are to be supplied by separate feeders as required in the present Chapter and in other Parts of the Rules. It is allowed to feed the equipment specially listed in 4.3.1 from the switchgear of the integrated bridge control console provided the requirements of 4.5.2 to 4.5.6 are met.

4.5.2 The switchgear of the integrated bridge control console is to be fed from the main switchboard directly or through transformers by two independent feeders connected to different sections of the main switchboard busbars (if busbars are sectioned). If an emergency generator is available on board the ship the supply of the integrated bridge control console switchgear is to be effected by one feeder from the main switchboard and by one feeder from the emergency switchboard.

4.5.3 Switchgear of the integrated bridge control console is also to be independently supplied by a separate feeder from other source or sources if it is necessary reasoning from the requirements for the equipment fed from these switchgear, or due to other technical reasons.

4.5.4 The switchgear is to be fitted with the switch of feeders required by 4.5.2.

Where an automatic switch is applied, manual switching of feeders is also to be ensured. Provision is to be made therewith for the necessary interlocking.

4.5.5 Each consumer among listed in 4.3.1 fed from the switchgear of the integrated bridge control console is to be supplied by a separate feeder.

4.5.6 A visual alarm indicating supply voltage presence is to be fitted in the integrated bridge control console.

4.6 SWITCHGEAR

4.6.1 Switchboard design.

4.6.1.1 Frames, front panels and enclosures of main, emergency, section and group switchboards are to be manufactured of metal or other durable non-combustible material.

4.6.1.2 Switchboards are to be of sufficiently rigid structure which is capable of withstanding the mechanical stresses liable to occur in service or due to short circuits.

4.6.1.3 Switchboards are, at least, to be protected from dripping. This protection is not required if switchboards are intended for installation in places where dripping onto switchboards is not expected (refer also to 4.6.6.2).

4.6.1.4 Switchboards for installation in places accessible to unauthorized persons are to be fitted with doors to be opened with a special key which is the same for all the switchboards on board the ship.

4.6.1.5 The design of switchboard doors is to be such that when opened, access is ensured to all parts to be maintained, and the live parts placed on the doors are to be protected against inadvertent touching.

The opening panels and doors, which are used for mounting electrical control gear and instruments are to be securely earthed with at least one flexible jumper.

4.6.1.6 Main, emergency and section switchboards, as well as control panels are to be provided with handrails arranged on their front side. The switchboards accessible from the rear are to be provided with horizontal handrails fitted behind the switchboard. Insulating material, wood or earthed metal pipes having the relevant insulating covering may be used as the material for handrails.

4.6.1.7 Generator panels of main switchboards are to be illuminated with lighting fixtures supplied on the generator side before the main breaker or not less than from two different systems of busbars where such systems are available.

4.6.1.8 The lighting of the front side of switchboard panels is not to interfere with observation or produce a blinding effect.

4.6.1.9 The design of switchboards which have no space at the rear is to be such as to ensure access to all parts which require maintenance.

Arrangements are to be provided for doors of switchboards and distribution cabinets to fix them in the open position.

Instruments and devices that need observation and maintenance are to be arranged at a height not more than 2 m.

4.6.1.10 Each switchgear designed for a voltage 127 V and over fitted with switching and protective equipment and having no voltmeter is to be provided with a pilot lamp indicating the presence of a voltage on busbars.

4.6.2 Busbars and uninsulated conductors.

4.6.2.1 The limiting heating temperature of switchboard busbars and uninsulated conductors at the rated load and short circuit or at the permissible one-second short-circuit load for copper busbars is to be determined according to national standards.

4.6.2.2 Equalizer busbars are to be designed for at least 50 per cent of the rated current of the largest generator connected to the main switchboard.

4.6.2.3 Where a busbar is in contact with or close to insulated parts, its heat effects are not to cause under operating or short-circuit conditions the temperature rise in excess of that permissible for the given insulating material.

4.6.2.4 Busbars and uninsulated conductors in switchboards are to have dynamic and thermal strength when carrying short-circuit currents occurring at the relevant points in the circuit. Electrodynamic loads arising in the busbars and uninsulated conductors in short-circuit conditions are to be determined according to national standards.

4.6.2.5 Insulators and other parts intended for fastening busbars and uninsulated conductors are to be capable of bearing the loads arising at short-circuits.

4.6.2.6 Busbars are to be connected so as to prevent corrosion in way of their connection.

4.6.3 Calculation of short-circuit currents and selection of electrical switch apparatus.

4.6.3.1 Electrical switch apparatus is, at least, to meet the national standards and be so chosen that:

.1 their rated voltages, currents and permissible temperatures are not exceeded under normal operating conditions;

.2 they are capable of bearing overloads under transient conditions without damage or heating above a limiting temperature;

.3 their characteristics under short-circuit conditions are consistent with the actual short-circuit power factor, as well as with the behaviour of subtransient and transient short-circuit currents.

4.6.3.2 The rated breaking capacity of electrical switch apparatus designed to break short-circuits currents is to be not less than the prospective short-circuit current at the point of its installation at the moment of breaking.

4.6.3.3 The rated making capacity of circuit breakers and switches that may be incorporated in a shorted electric circuit is not to be less than the prospective maximum making current at the point of their installation under short-circuit conditions.

4.6.3.4 The electrodynamic strength current of electrical apparatus not designed for interrupting short-circuit currents is not to be less than the prospective maximum short-circuit current at the point of its installation.

4.6.3.5 The thermal strength current of electrical apparatus under short-circuit conditions is to be consistent with the prospective short-circuit current at the point of its installation with due regard for short-circuit duration attributed to the selective action of protection devices.

4.6.3.6 The use of a circuit breaker with inadequate breaking and/or making capacities relative to the prospective maximum short-circuit current at the point of its installation is allowable provided that it is protected on the generator side with fuses and/or a circuit breaker with at least necessary ratings for short-circuit currents and which is not used as the automatic switching device of the generator.

The characteristics of the protection arrangement thus composed are to be such that:

.1 while breaking the prospective maximum short-circuit current, the circuit breaker on the load side is not damaged so as to become unfit for further operation;

.2 while making the circuit breaker on the prospective maximum short-circuit current, the remaining part of the electrical arrangement is not damaged; in this case, it is allowed for the circuit breaker on the load side not to be immediately fit for further operation.

4.6.3.7 Circuit breakers are to be fitted for overload protection in electric circuits with the rated load current over 320 A.

The use of circuit breakers is recommended at the current over 200 A.

4.6.3.8 Circuit breakers in the circuits of direct-current compound generators intended for parallel operation are to have a pole in a balancing wire mechanically mated with the other poles of the circuit breaker so that it switches on prior to the connection to the busbars of the rest poles and switches off after their disconnection.

4.6.3.9 Short-circuit currents are to be calculated basing on the standards or calculation methods approved by the Register.

4.6.3.10 When calculating maximum short-circuit currents the short-circuit current source is to include all generators and synchronous condensers, which may be connected in parallel, and all simultaneously running motors. The currents from generators and motors are to be calculated on the basis of their characteristics.

If the precise data is unavailable, the following ratios of the effective value of an injection current for the short-circuit point is to be assumed for alternating current electric motors:

6,25 I_r – for the instant of short-circuit occurrence;

2,5 I_r – for the instant T, i.e. after one cycle from short-circuit inception;

I_r – for the instant $2T$, i.e. after two cycles from short-circuit inception;

8 I_r – for a shock current (I_r = total rated current of all the electric motors simultaneously running under design conditions).

When calculating the maximum value of short-circuit current in direct-current systems the injection current from electric motors is assumed equal to the six-fold value of the rated currents sum for the electric motors simultaneously running under design conditions.

The calculating of short-circuit currents is to be made for all the design short-circuit points necessary for the selection or testing of power electric circuit elements.

In any case, the short-circuit current calculation is to be made for the following design points:

on the generator side (at circuit breaker terminals);

on the main switchboard busbars;

on the emergency switchboard busbars;

on the terminals of consumers and the busbars of the switchboards supplied directly from the main switchboard.

The calculation of the minimum short-circuit current is to be made if it is required for the assessment of protection sensitivity.

The calculation of short-circuit currents is to contain the list of electrical switch apparatus fitted including their characteristics, and also the prospective short-circuit current at the places of their installation.

4.6.4 Arrangement of electrical switch apparatus and measuring instruments.

4.6.4.1 Apparatus, measuring and indicating instruments relating to the relevant generators and other large essential installations are to be fitted on the switchgear associated with these generators and installations. This requirement may be ignored for generators if there is a central control console with switchgear and measuring instruments of several generators.

4.6.4.2 One ammeter and one voltmeter are to be provided for each direct-current generator on the main and emergency switchboards.

4.6.4.3 The following measuring instruments are to be fitted on the main switchboard for each alternating current generator and on the emergency switchboard for an emergency generator:

.1 ammeter with a selector switch for current measurements in each phase;

.2 voltmeter with a selector switch for measuring phase or line voltages;

.3 frequency indicator (it is allowed to use one double frequency indicator for generators running in parallel with change-over to each generator);

.4 wattmeter (for output over 50 kVA);

.5 other instruments as required.

4.6.4.4 For ships with a low-power electrical installation on which the parallel operation of generators is not provided, it is allowed to fit on the main and emergency switchboards one set of measuring instruments specified in 4.6.4.2 and 4.6.4.3 ensuring the possibility of measurements at each generator installed.

4.6.4.5 Ammeters are to be provided in the circuits of essential consumers rated at 20 A and over. These ammeters may be fitted on the main switchboard or at control stations. It is allowed to install ammeters with selector switches, but not more than for six consumers.

4.6.4.6 On the main switchboard the feeder from the external source of electrical power is to be provided with:

.1 switchgear and protective devices;

.2 voltmeter or pilot lamp;

.3 phase break protection device.

4.6.4.7 A switched or separate for each circuit device to measure and indicate insulation resistance, as well as visual and audible alarm of impermissible reduction of insulation resistance are to be fitted on the main and emergency switchboards for each circuit of isolated systems.

In any case, the hull leakage current due to the operation of a measuring device is not to exceed 30 mA.

On ships with unattended machinery spaces the above alarm is to be arranged in the location where from the ship's control is effected.

4.6.4.8 Measuring instruments are to have scales with the margin of divisions exceeding the rated values of quantities to be measured.

The upper scale limits of the instruments used are to be not less than:

.1 for voltmeters – 120 per cent of the rated voltage;

.2 for ammeters related to the generators not running in parallel, and to consumers – 130 per cent of the rated current;

.3 for ammeters related to the generators running in parallel – 130 per cent of the rated current for the load current scale and 15 per cent of the rated current for the reverse current scale (the latter refers to direct-current generators only);

.4 for wattmeters related to the generators not running in parallel – 130 per cent of the rated output;

.5 for wattmeters related to the generators running in parallel – 130 per cent for the load power scale and 15 per cent for the reverse power scale;

.6 for frequency indicators – +10 per cent of the rated frequency.

The above scale limits may be changed on agreement with the Register.

4.6.4.9 Voltage, current and power ratings of circuits of the electric propulsion plant and generators are to be clearly marked on the scales of instruments.

4.6.4.10 Breakers are to be fitted and connected to busbars so that movable contacts and all the breaker-related protective and control equipment are not energized when the breaker is in the off-position.

4.6.4.11 Where breakers with fuses are used in switchboard circuits, the fuses are to be located between the busbars and breakers. Another pattern of fuse installation is allowed only on agreement with the Register.

4.6.4.12 Fuses in the switchboards installed on a foundation at the floor level are to be located within the range of 150 mm to 1800 mm above the floor. Live open parts of switchboards are to be at least 150 mm above the floor.

Controls of generator apparatus are to be located not lower than 800 mm above the floor. Controls of other apparatus are to be at least 300 mm above the floor.

4.6.4.13 Fuses in switchboards are to be so fitted that they are readily accessible and the replacement of fuse links is safe for the operating personnel.

4.6.4.14 Screwed-in fuses are to be so fitted that input leads are connected on a lower terminal.

4.6.4.15 The fuses protecting the poles or phases of the same circuit are to be fitted side be side horizontally or vertically depending on the fuse design. The mutual layout of fuses in an alternating current circuit according to phases sequence is to be from left to right or from top to bottom.

The fuse of a positive pole in a direct-current circuit is to be located at the left, at the top or closer to the operating personnel.

4.6.4.16 The manual actuators of voltage regulators fitted on the main or emergency switchboard are to be located close to the measuring instruments relating to the relevant generators.

4.6.4.17 The ammeters of direct-current compound generators intended for operation in parallel are to be fitted in the circuit of the pole not connected to a common wire.

4.6.4.18 Flexible stranded conductors are to be used for connecting portable or semi-portable instruments.

4.6.4.19 Controls of electrical switch apparatus, panels, outgoing electrical circuits on switchboards and measuring instruments are to have their designations marked.

The switching positions of apparatus are also to be indicated.

The rated currents of fuses and breakers installed, the settings of circuit breakers and thermal electrical relays are to be indicated as well.

4.6.4.20 Each outgoing circuit in a switchboard is to be provided with a breaker disconnecting all poles and/or phases. Breakers may be omitted in secondary lighting switch boxes provided with a common breaker, and also in the circuits of instruments, interlocking and signalling devices, local lighting of switchboards protected with fuses.

4.6.5 Visual alarm.

The colors specified in Table 4.6.5 are to be used for visual alarm. The application for visual alarm of the ways other than specified in Table 4.6.5 (e.g. letter symbols) is in each case subject to special consideration by the Register.

4.6.6 Arrangement of switchgear.

4.6.6.1 Switchgear are to be installed in locations where the concentration of gases, water vapours, dust and acid evaporations does not occur.

4.6.6.2 If the switchgear with the protective enclosure of the IP10 type and below is located in a special space, cabinet or recess, then such spaces are to be made of non-combustible materials or to have the lining of such materials.

Table 4.6.5

Color	Meaning	Signal type	Condition of device
Red	Danger	Flashing	Alarm in dangerous conditions when a prompt response is required
		Steady	General alarm in dangerous conditions, as well as in dangerous conditions detected, but not eliminated yet
Yellow	Attention	Flashing	Abnormal conditions when a prompt response is not required
		Steady	Intermediate condition between abnormality and safety. Abnormal condition detected, but not eliminated yet
Green	Safety	Flashing	Standby machinery is put into operation
		Steady	Normal conditions of running and operation
Blue	Information	Steady	Machinery and gear are ready for starting. Energized mains. Everything is O.K.
White	General information	Steady	Signals activated when necessary. Notations relating to automatic operation. Other auxiliary signals

4.6.6.3 Arrangement of pipelines and tanks near switchboards is to meet the requirements of 5.5, Part VII "Systems and Piping".

4.6.6.4 The navigation lights switchboard is to be located in the wheelhouse at the place readily accessible and visible to the personnel on watch.

4.6.6.5 The main switchboard and generator sets are to be located in the same space (in one main vertical fire zone for passenger ships).

The enclosure within the main boundaries of a machinery space provided for the main engine control room and where the main switchboard is located, is not considered as separating the main switchboard from generator sets.

4.6.7 Access to switchboards.

4.6.7.1 A passageway of at least 600 mm wide for switchboards up to 3 m long, and at least 800 mm wide for switchboards over 3 m long, is to be provided in front of the switchboard.

4.6.7.2 A passageway of at least 600 mm wide is to be provided on the rear lengthwise of free standing switchboards.

If specially required, this value may be reduced on agreement with the Register.

4.6.7.3 The space behind free standing switchboards with open live parts is to be enclosed and provided with doors according to 2.7.1.

4.6.7.4 The space behind switchboards over 3 m in length specified in 4.6.7.3 is to be provided with at least two doors from the space in which the switchboard is installed. These doors are to be as widely spaced as possible. One of these doors may open into the adjacent space which, at least, has another exit.

4.6.7.5 The passageways specified in 4.6.7.1 and 4.6.7.2 are measured from the most protruding parts of apparatus and structures of the switchboard to those of equipment or hull structures.

5 ELECTRIC DRIVES OF THE SHIP'S MACHINERY AND EQUIPMENT

5.1 GENERAL

5.1.1 Control stations of drives are to meet the appropriate requirements of Section 3, Part VI "Machinery Installations".

5.1.2 Electrically-driven machinery is to be provided with visual alarm of the electric drive switching.

5.1.3 Equipment having automatic, remote and local control is to be designed so that the automatic and remote control is switched off with the change-over to the local control.

The local control therewith is to be independent of automatic or remote control.

5.2 INTERLOCKING OF MACHINERY OPERATION

5.2.1 The machinery having electric and manual drives is to be fitted with an interlocking device preventing simultaneous operation of drives.

5.2.2 Where machinery is brought into operation in a certain sequence, appropriate interlocking devices are to be used which diagram and design are subject to special consideration by the Register.

5.2.3 It is allowed to use the device switching off an interlock provided it is protected against the inadvertent switching-off of the interlock. An information inscription is to be placed near the above device indicating its purpose and forbidding its use by unauthorized personnel. Such a device is not allowed for machinery specified in 5.2.1.

5.2.4 Starting of the machinery which electric motors or apparatus require additional ventilation in a normal operation is to be possible with operating ventilation only.

5.3 SAFETY ISOLATION DEVICES

5.3.1 Control systems of machinery which operation in certain conditions may endanger human or the ship's safety are to be provided with push-buttons or other safety isolation devices ensuring the disconnection of an electric drive from power supply.

These push-buttons and/or other safety isolation devices are to be protected against inadvertent activation.

5.3.2 Push-buttons or other safety isolation devices are to be located at control stations or in other places ensuring operation safety.

5.3.3 Electric drives of arrangements and machinery, which require the restriction of motion to prevent damage or emergency, are to be provided with terminal switches to ensure the reliable isolation of the electric motor.

5.4 SWITCHGEAR AND CONTROL GEAR

5.4.1 The switchgear in the electric drive circuits which does not provide for short-circuit protection is to withstand the short-circuit current that may flow at the point of its installation during the time required for protection activation.

5.4.2 Control gear is to provide an opportunity to start an electric motor from a zero position only.

5.4.3 A device for field killing is to be provided for the control gear permitting the isolation of shunt-field windings.

5.4.4 Each electric motor rated at 0,5 kW and over and its control gear are to be provided with a device to isolate the power supply. In this case, where the control gear is mounted on the main or any other switchboard in the same space and its visibility from the place of electric motor installation is ensured, then, for this purpose it is allowed to use the switch mounted on the switchboard.

If the above requirements for control gear arrangement are not met, the following is to be provided:

.1 device interlocking the switch on the switchboard in the off-position;

.2 additional switch near the electric motor;

.3 such installation of fuses in each pole or phase that they are readily removed and replaced by operating personnel.

5.5 ELECTRIC DRIVES AND CONTROL OF STEERING GEAR

5.5.1 In addition to the requirements of 6.2, Part VIII "Machinery" and of 2.9, Part III "Equipment, Arrangements and Outfit", steering gear is to meet the requirements of the present Part.

5.5.2 The main electric or electro-hydraulic steering gear comprising one or more power units is to be supplied by two separate feeders laid directly from the main switchboard in different cable runs.

Where sectionalized busbars are used in the main switchboard, each feeder is to be supplied from different sections (refer also to 4.3.2). One of the feeders may by supplied through the emergency switchboard.

5.5.3 Where the steering gear has an auxiliary electric or electro-hydraulic gear according to 2.9, Part III "Equipment, Arrangements and Outfit", it may be supplied from the feeders of the main steering gear.

5.5.4 The operating conditions of electric motors for the drives of active means of the ship's steering are to be consistent with the conditions specified for the entire arrangement, but the motors are, at least, to meet the short-term operating conditions during not less than 30 min.

5.5.5 The electric and electro-hydraulic drives of steering gear are to ensure:

.1 putting the rudder from hard over to hard over within the time and angle specified in 2.9.6 and 2.9.7, Part III "Equipment, Arrangements and Outfit";

.2 putting the rudder continuously from hard over to hard over during 30 min for each unit when the rudder is fully immersed and at the maximum speed ahead corresponding to this draught (refer also to the requirements of Part III "Equipment, Arrangements and Outfit");

.3 possible stalling of an electric motor alive for one minute from a hot state (only for rudders provided with a direct electric drive);

.4 adequate strength of an electric drive under forces arising at the ship's maximum speed astern.

It is recommended to ensure the opportunity of putting the rudder over at the average speed astern.

5.5.6 Starting and stopping of steering gear, electric motors except electric motors of rudders with a direct electric drive, are to be effected from the steering compartment and wheelhouse.

5.5.7 Starting devices are to ensure automatic restarting of electric motors as soon as a voltage is restored after discontinuity in power supply.

5.5.8 An audible and visual alarm is to be given in the wheelhouse in case of:

.1 voltage loss and overload in each power unit supply circuit;

.2 voltage loss in the control system supply circuit;

.3 low oil level in any tank of the hydraulic system.

In addition, means indication is to be provided on operation of electric motors of steering gear power units.

5.5.9 The electric drive control systems of steering gear specified in 2.9, Part III "Equipment, Arrangements and Outfit" are to be supplied by separate feeders laid in different cable runs from the steering gear power circuits in the steering compartment or directly from the busbars of the switchgear feeding these power circuits.

5.5.10 The control of the main and auxiliary steering gear is to be effected from the control station in the wheelhouse.

Each remote control system specified in 2.9, Part III "Equipment, Arrangements and Outfit" is to have its own independent circuit for transmission of control signals to the steering gear actuator.

The switch of control systems at the rudder control station is to be provided for change-over of steering gear control systems.

Where several control stations for electric drives of steering gear are available, the switch ensuring the functioning of one control station only is to be provided.

5.5.11 The direction of handwheel rotation or control gear handle motion is to be consistent with the direction of putting the rudder over.

If a push-button control system is used, push-buttons are to be so arranged that the actuation of the push-button on the right side ensures the rudder blade movement to the right, and of the button on the left side, to the left.

5.6 ELECTRIC DRIVES OF ANCHOR AND MOORING MACHINERY

5.6.1 In addition to the requirements in Section 6, Part VIII "Machinery", the drives of windlasses, anchor and mooring capstans, and mooring winches are to meet the requirements of the present Part.

5.6.2 When alternating-current squirrel-cage motors are used, the electric drives of anchor and mooring machinery are to ensure, after 30 min operation at the rated load, possible stalling of the electric motor alive at the rated voltage for at least 30 s for the anchor machinery and 15 s for the mooring machinery. For pole-changing motors, this requirement is applicable to the operation of motors with the winding producing the maximum starting torque.

Direct-current motors and alternating-current wound-rotor motors are to withstand the above stalling conditions, but at the torque twice that of the rated value and the voltage therewith may be below the rated value.

Following stalling alive the temperature rise is not to be over 130 per cent of the permissible value for the insulation used.

5.6.3 In anchor and mooring capstans, and mooring winches at the speed steps intended for mooring operations only, provision is to be made for the electric motor overload protection.

5.6.4 The power supply of electric drives of anchor capstans is to meet the requirements of 4.3.1.

5.7 ELECTRIC DRIVES OF PUMPS

5.7.1 The electric motors of fuel oil and lubricating oil transfer pumps, and separators are to be fitted with remote disconnecting devices located outside the spaces of these pumps and outside the trunks of machinery spaces, but in close vicinity of exits from these spaces.

5.7.2 Disconnecting devices of electric drives specified in 5.7.1 are to be located in conspicuous places covered with glass and provided with explanatory inscriptions.

5.7.3 Remotely-controlled fire pumps are to have a local control station as well.

Local starting of fire pumps is to be possible even if their remote control circuits fail.

5.7.4 The electric motors of oily and sewage water transfer or discharge pumps are to be fitted with remote cut-off arrangements placed close to discharge manifolds unless telephone communication between the discharge observation place and discharge pump control place is provided.

5.8 ELECTRIC DRIVES OF FANS

5.8.1 The electric motors of machinery space fans are to have at least two disconnecting devices one of which is to be placed outside these spaces and their trunks, but in close vicinity of the exit from these spaces.

It is recommended to arrange these disconnecting devices together with the similar devices specified in 5.7.1.

5.8.2 The electric motors of cargo holds and galley fans are to have disconnecting devices at places readily accessible from the main deck, but outside machinery space trunks. The electric motors of exhaust ventilation from galley ranges are to be provided with a disconnecting device placed inside the galley regardless of the number of disconnecting devices.

5.8.3 The electric motors for the ship's general ventilation are to have at least two devices for their remote disconnection with one of them located in the wheelhouse and another one accessible from the open deck. For ships with the electrical installation of low power (other than passenger ships) it is allowed to use one device of remote disconnection located in the wheelhouse or in a place readily accessible from the main deck.

5.8.4 The electric motors of fans in spaces protected by a fire-smothering system are to have a disconnecting device automatically activated with the discharge of an extinguishing medium into the given space.

5.8.5 The disconnecting devices of electric motors of fans listed in 5.8.1, 5.8.2 and 5.8.3 are to be so grouped on board the ship that all these electric motors can be stopped from not more than three places.

5.9 ELECTRIC MOTORS OF BOAT WINCHES

5.9.1 Controls of the electric drive of the boat winch are to be provided with the device of self-reset in the "STOP" position.

5.9.2 A power circuit switch for the electric motor is to be located immediately at the boat winch control station.

5.9.3 An opportunity to switch on the electric drive of the boat winch while a manual drive handle is in use, is to be prevented.

5.9.4 The boat winch control station is to be so located that the operator can observe boat hoisting all the way from the water surface till the place of its installation.

5.10 ELECTRIC DRIVE OF THE WHEELHOUSE HOISTING

5.10.1 The electric drive of the wheelhouse hoisting is to be provided with two disconnecting devices with one of them placed in the wheelhouse and another at the hoisting machinery control station.

It is allowed to have one disconnecting device immediately at the control station where the hoisting machinery control station is arranged in the wheelhouse.

5.10.2 An opportunity to lower the wheelhouse in emergency from inside, when the power supply fails, is to be provided.

5.11 ELECTRIC DRIVES OF WATERTIGHT AND FIRE DOORS

5.11.1 The electric drives of watertight doors are to ensure the compliance with the requirements of 9.6, Part III "Equipment, Arrangements and Outfit".

5.11.2 Power supply of electric drives and indicators of watertight doors position and closure is to be effected from the main, emergency and emergency temporary (if any) sources of electrical power in accordance with the requirements of 4.3.1, 9.3 and 19.1.2.

5.11.3 The electric drives of devices holding fire doors open (see Part V "Fire Protection") are to:

.1 be supplied from the main and emergency sources of electrical power;

.2 be remotely controlled form the wheelhouse ensuring the closure of any door, group of doors or all doors at a time;

.3 automatically close all the doors at a time in case of the supply voltage loss;

.4 be so designed that any damage to closing appliance of any door can not render inoperative the systems of other doors supply and control.

6 LIGHTING

6.1 GENERAL

6.1.1 Stationary main lighting fixtures supplied from the main source of electrical power are to be fitted in all the ship's spaces, locations and zones where illumination is essential for navigation safety, machinery and gear control, habitability and evacuation of passengers and crew.

The list of spaces, locations and zones where the emergency lighting fixtures are to be fitted in addition to the main ones is given in 9.3.1.1 and 19.1.3.1.1.

6.1.2 Lighting fixtures fitted in spaces and zones where a mechanical damage to their globes is probable are to be provided with protective gauzes.

6.1.3 Lighting fixtures are to be installed in such a manner as to prevent heating of cables and nearby materials up to the temperature exceeding the permissible one.

6.1.4 External-illuminating lighting fixtures are to be so installed that light interference with the ship's navigation is prevented.

6.1.5 Accumulator battery and other hazardous spaces are to be illuminated with lighting fixtures located in adjacent safe spaces through gastight glazed windows or with safe-type lighting fixtures located inside the spaces (refer also to 2.9).

6.1.6 High-temperature wires are to be provided for internal wiring in lighting fixtures.

A bolt for earthing is to be provided on the body of a lighting fixture.

A reliable electrical contact is to be ensured between all the metal parts of the lighting fixture.

6.2 POWER SUPPLY OF MAIN LIGHTING ELECTRIC CIRCUITS

6.2.1 The switchboards of the main lighting are to be supplied by separate feeders. The electric drives of non-essential services rated up to 0,25 kW and individual electric heaters in cabins rated up to 10 A may be supplied from the main lighting switchboards.

6.2.2 The protective devices of end branches of lighting circuits are to be designed for a rated current not exceeding 16 A. The total load current of the consumers connected is not to exceed 80 per cent of the rated current of the protective device.

The number of lighting fixtures fed from end lighting circuits is not to exceed that specified in Table 6.2.2.

Cabin fans and other minor consumers may be supplied from end lighting circuits.

Table 6.2.2

Voltage, in V	Maximum number of lighting fixtures
Up to 50	10
From 51 to 120	14
From 121 to 250	24

6.2.3 Lighting of corridors, machinery spaces, shafting tunnels is to be supplied by at least two independent feeders with lighting fixtures arranged in such a manner that even in case of any feeder failure, as uniform lighting as possible, is ensured. These feeders are to be supplied from different group switchboards, which in case of application of sectionalized lighting busbars in the main switchboard, are to be fed from different busbar sections.

The supply of the above spaces (except machinery spaces) lighting for cargo ships with the electrical installation of low power may be effected by one feeder from a group switchboard or immediately from the main switchboard.

6.2.4 Local lighting fixtures in accommodation spaces, as well as plug sockets are to be supplied from the lighting switchboard by a separate feeder, other than the one for supplying general lighting fixtures.

6.3 EMERGENCY LIGHTING

6.3.1 The illumination of separate spaces, locations and zones specified in 19.1.3.1 at emergency lighting is to be at least 10 per cent of the general illumination at the main lighting (refer to 6.6). The illumination from emergency lighting fixtures in the machinery space may be 5 per cent of that at the main lighting where the plug sockets fed from the emergency lighting circuit are provided. This illumination is to be sufficient to readily find the way to escape routes (or to be equal to 0,5 lx).

6.3.2 In order to ensure the illumination required in 6.3.1, emergency lighting fixtures with incandescent lamps may be combined with luminescent lamps.

6.3.3 The main lighting fixtures may be used as emergency lighting fixtures where they can also be supplied from emergency sources of electrical power.

6.3.4 The emergency lighting circuit is to be so designed that the main lighting system does not fail in case of a fire or other emergencies in spaces where emergency sources of electrical power and/or emergency lighting transformers are located.

6.3.5 Stationary lighting fixtures with built-in accumulators and automatic recharging from the main lighting circuit having a relay switch may be used for emergency lighting.

6.3.6 Each emergency lighting fixture and lampholder of combined lamps (refer to 6.3.3) are to be marked red.

6.4 SWITCHES IN LIGHTING CIRCUITS

6.4.1 Two-pole switches are to be used in all lighting circuits. In dry accommodation and service spaces, single-pole switches may be used in circuits disconnecting individual lighting fixtures or groups of lighting fixtures rated at not more than 6 A, as well as lighting fixtures designed for safety voltage.

6.4.2 The means of centralized disconnection for all lighting fixtures from the wheelhouse or from another permanent watch station on the open deck are to be provided for fixed external-illumination lighting fixtures.

6.4.3 The switches of lighting circuits of fire extinction stations and service spaces with the high level of fire hazard (refer to Part V "Fire Protection") are to be located outside these spaces.

6.4.4 Provision is to be made for switches in supply circuits of stationary lighting fixtures for cargo holds.

The switches are to be placed outside cargo holds in locations accessible to the authorized personnel only, and to have clearly distinguishable indication of the switch handle position, or signal lamps indicating the switched-on condition of cargo holds lighting.

6.4.5 Local switches of lighting fixtures are not to be used in emergency lighting circuits. It is allowed to use them in circuits of emergency lighting fixtures, which are the main lighting fixtures under normal conditions.

Emergency lighting in the wheelhouse is to be provided with a switch.

Emergency lighting fixtures of embarkation stations, which are used as main lighting fixtures under normal conditions, are to switch on automatically when the ship is de-energized.

6.5 SOCKET OUTLETS

6.5.1 Socket outlets for portable lighting are to be installed at least in the following places:

.1 on deck near the windlass;
.2 in the gyrocompass room;
.3 in the radio equipment converters room;
.4 in the steering gear compartment;
.5 in the emergency generator set compartment;
.6 in machinery spaces;
.7 behind the main switchboard;
.8 in special electrical spaces;
.9 in the wheelhouse;
.10 in the radioroom;
.11 in way of log and echo-sounder enclosures.

6.5.2 Socket outlets fed with different voltages are to have a design preventing the insertion of a plug intended for a certain voltage into a socket for a higher voltage.

A supply voltage is to be indicated on the socket outlet or at the place of its installation.

6.5.3 Socket outlets for portable lighting and the other consumers of electrical power located on open decks are to be mounted facing downwards or sideways up to 90º.

6.5.4 Socket outlets are not to be fitted in machinery spaces below the plating, in enclosed spaces for fuel oil and lubricating oil separators or in places where approved safety-type equipment is required.

6.5.5 The installation of socket outlets in cargo holds is not allowed except those required for supply of isothermal containers.

In this case, they are to be fed from the special switchboard located outside the cargo hold and supplied by a separate feeder (refer to 19.4.2).

Socket outlets are to be located in places protected against mechanical damages.

6.5.6 Socket outlets for a rated current over 16 A are to be provided with an interlock switch preventing plug and socket disconnection and connection in the on-position of the switch, and a plate indicating voltage.

6.5.7 In bath- and wash-rooms it is allowed to install socket outlets with a permissible operating voltage specified in Table 4.2.2.

It is not allowed to mount socket outlets and switches in shower-rooms or near baths. The exception may be socket outlets with isolating transformers for electric-powered shavers.

6.6 ILLUMINATION

6.6.1 The illumination of separate spaces and zones is to be not less than that specified in Table 6.6.1. These requirements are not applicable to ships with lighting designed for a voltage below 50 V.

The standards of general illumination given in Table 6.6.1 refer to a level of 800 mm above the deck (plating) in a space, and the standards of general plus local illumination, to the level of working surfaces.

Table 6.6.1

Nos	Spaces and surfaces	Illumination, in lx			
		Luminescent lamps		Incandescent lamps	
		General + local	General	General + local	General
1	Radioroom:				
	above the deck at the set level	100	-	100	-
	operator tables in the radioroom	100	-	100	-
2	Chartroom:				
	above the deck at the set level	-	100	-	50
	chart tables	150	-	150	-
3	Wheelhouse:				
	above the deck at the set level	-	75	-	50
4	Machinery spaces, switchboard spaces, spaces for manoeuvring and control stations and panels, automated facilities, gyrocompasses:				
	above the plating at the set level				
	surfaces of switchgear and control desks	-	75	-	75
	main machinery control locations	200	100	150	75
	passageways between boilers, machinery	150	100	150	75
	ladders, platforms, etc.	-	75	-	30
	in front of boilers	100	75	75	75
5	Accumulator battery room:				
	above the deck at the set level	-	75	-	50

Table 6.6.1 - continued

Nos	Spaces and surfaces	Illumination, in lx			
		Luminescent lamps		Incandescent lamps	
		General + local	General	General + local	General
6	Shafting tunnels, log and echo sounder trunks, chain lockers: above the deck at the set level	-	30	-	10
7	Passageways on decks, areas of lifeboats and liferafts installation: above the deck at the set level	-	50	-	20
8	Overboard spaces in way of lifeboats and liferafts launching: near the load waterline	-	-	-	5

6.7 NAVIGATION LIGHTS

6.7.1 Navigation lights switchboard is to be supplied by two feeders:

.1 one feeder from the main switchboard through the emergency switchboard (if any);

.2 the second feeder from the nearest group switchboard which is not supplied from the emergency switchboard.

6.7.2 It is allowed to fit navigation lights control devices in the console located in the wheelhouse and fed in accordance with 4.5.

Where the main source of electrical power of the ship is an accumulator battery and the main switchboard is installed in the wheelhouse, navigation lights may be controlled directly from the main switchboard.

6.7.3 On ships, where navigation lights are fed – from the accumulator battery floating on a charging unit in the ship's running conditions, it is allowed not to provide the second feeder to supply the navigation lights switchboard.

6.7.4 Navigation lights switchboard is to supply the following lights:

.1 masthead lights (including “the triangle” of lights while push-towing);

.2 sidelights (including lights on a pushed train);

.3 poop light;

.4 stern lights;

.5 flashing lights.

Masthead, side and poop lights are to be supplied from navigation lights switchboard by separate feeders.

The stern lights and “the triangle” of masthead lights in push boats may be joined and supplied as the lights group from navigation lights switchboard. In this case, the pilot alarm is to be activated with the failure of both a separate lantern and a light as a whole.

6.7.5 Supply circuits of navigation lights are to be made according to a double-wire system and provision is to be made in each circuit for a two-pole switch installed on navigation lights switchboard.

6.7.6 Each navigation lights supply circuit is to have protection in both wires.

6.7.7 Provision is to be made for an audible alarm automatically activated when any navigation light fails with a switch in the on-position. Supply of the audible alarm is to be effected from the source or feeder other than those feeding navigation lights switchboard, or from an accumulator battery.

6.7.8 Supply of lights not specified in 6.7.4 may be effected from separated distribution boxes or the nearest lighting switchboard.

The temporarily-hoisted lights may be supplied from plug sockets of a lighting circuit.

7 INTERNAL COMMUNICATION AND ALARM

7.1 ELECTRIC ENGINE ROOM TELEGRAPHS

7.1.1 In addition to the present Chapter requirements, the engine room telegraphs are to meet the requirements of 3.3.1, Part VI "Machinery Installations".

7.1.2 Engine room telegraphs are to be provided with a visual alarm on the presence of voltage in the supply circuit and an audible alarm on the loss of voltage in the supply circuit.

7.1.3 Engine room telegraphs installed in the wheelhouse are to be fitted with a dial of regulated illumination.

7.1.4 Engine room telegraphs are to be supplied from the main switchboard or navigation devices switchboard. In case of the integrated bridge control console on board the ship, the engine room telegraph may be supplied from this console.

7.1.5 The engine room telegraph transmitter is to be so arranged that when orders for the ship's motion are given, the operating telegraph handle moves in the same direction with the ship. The vertical handle position is to correspond to the "STOP" order.

7.1.6 Where engine room telegraphs and devices for remote control of main engines and controllable pitch propellers are mounted on sloping desks of control panels, the handle in the "STOP" position is to be perpendicular to the panel surface and precisely fixed in this position.

7.1.7 Where more than one engine room telegraph is located in the immediate vicinity of one another (on the same deck), the order transmission and response receipt by any of them are to be simultaneously displayed by all telegraphs without additional changeovers.

Changeover to the telegraphs located on another deck or in another part of the ship is to be effected with the use of switches arranged on the navigating bridge.

7.1.8 Each engine room telegraph is to be fitted with an audible signal arrangement ensuring the activation of an audible signal on the navigating bridge and in the engine room when orders are given and the response is received. With a wrong response, the operation of the audible signal arrangement is to continue.

7.2 INTERNAL SERVICE COMMUNICATION

7.2.1 In the absence of other types of two-way voice communication, provision is to be made for independent two-way telephone communication between the wheelhouse and main machinery control stations, and between the wheelhouse and radioroom.

7.2.2 Provisions are also to be made for the telephones of the ship's control group, which are to ensure communication between the wheelhouse and main service spaces and stations in which the equipment ensuring the ship's navigation safety is located. Instead of those telephones, a two-way loudspeaking device may be used.

7.2.3 Service communication systems are to ensure the possibility of the subscriber's signaling and clear voice communication in the conditions of specific noise in places of communication facilities installation.

When service telephone sets are located in very noisy spaces, measures are to be taken for noise absorption or additional earphones are to be provided. These spaces are also to be fitted with audible and visual alarm on signalling.

7.2.4 For communication facilities specified in 7.2.1 and 7.2.2 the use is to be made of sound-powered telephones or provision is to be made for supply from an accumulator battery automatically activated with the loss of supply from the ship's mains.

7.2.5 A damage or disconnection of one telephone set is not to interfere with operability of other sets.

7.2.6 The telephone network is to be isolated.

7.3 GENERAL ALARM SYSTEM

7.3.1 The ships in which a general alarm given by voice or other means cannot be heard simultaneously in all possibly manned locations, are to be fitted with an electric general alarm system that ensures good audibility of signals in all such places.

7.3.2 Sound devices are to be installed in the following places:

.1 in machinery spaces;

.2 in public spaces with an area over 150 m^2;

.3 in corridors of accommodation, service and public spaces;

.4 on open decks.

The red lamp of a general alarm system instead of the sound device is to be installed in the radioroom within sight of an operator.

7.3.3 A general alarm system is to be supplied from the main and emergency sources of electrical power.

It is allowed to supply the general alarm system from the ship's mains and from the accumulator battery automatically activated with the ship's mains voltage loss.

7.3.4 A general alarm system is to be continuously supplied no matter whether an accumulator battery is being charged or discharged.

7.3.5 Where a separate accumulator battery is used to feed a general alarm system, it may also be used for supplying other internal communication facilities if the battery capacity is sufficient for simultaneous supply of all consumers during at least 3 hours, and also if these facilities are so designed that a damage to one circuit does not interfere with functioning of other circuits.

7.3.6 Short-circuit protection only is to be provided in supply circuits of a general alarm system. Protection devices are to be fitted in both conductors of the feeder, as well as in the circuits of each sound device. Protection of several sound devices with one common protective device is allowed provided that in spaces, where they are installed, good audibility of other sound devices with independent protection is ensured.

7.3.7 General alarm sound devices are to be so arranged that a signal is clearly heard against the noise in the given space. The sound devices in spaces with high noise intensity are to be provided with a visual alarm. The tonality of general alarm devices is to be unlike that of other kinds of alarms.

7.3.8 The general alarm system is to be activated with a two-pole self-reset contactor from the wheelhouse and from the space, if any, where the watch is kept in port.

If the general alarm signal is not heard in the wheelhouse or station where it is given, a pilot lamp is to be fitted after the switch to indicate the activation of the general alarm system. The switches are to be provided with the inscriptions indicating their purpose.

7.3.9 No switching devices are to be fitted in the circuits of the general alarm system except the switch specified in 7.3.8. Where a power supply switch is fitted on the general alarm system switchboard, it is to have an interlock in the on-position or to be otherwise protected against access thereto of unauthorized persons.

It is allowed to use intermediate closing contactors turned on by a switch, but not more than one closing contactor in each section.

7.3.10 Sound devices, switches and switchgear of the general alarm system are to have readily visible distinctive symbols.

7.3.11 If the ship is provided with sound devices of a general alarm system, the circuit is to consist of at least two sections controlled by one switch, and the sound devices are to be located in such a manner that large area spaces (machinery, boiler and other spaces) are fitted with sound devices from different sections.

7.4 FIRE DETECTION AND ALARM SYSTEM

7.4.1 In addition to the requirements of the present Chapter, fire detection and alarm systems are to meet the requirements of Section 5, Part V "Fire Protection".

7.4.2 The use of detectors of a fire detection and alarm system located in spaces of potential explosive vapours accumulation or being in the flow of air exhausted from these spaces is regulated by 2.9 and 19.2.

7.4.3 A fire detection and alarm system is to be provided with at least two sources of electrical power, one of them being an emergency one. The power supply is to be effected by separate feeders intended for this purpose only. With the loss of supply from the main source of electrical power, the automatic changeover of the supply to the emergency source, audibly and visually alarmed, is to be provided.

Where an accumulator battery is the main source of power, two separate accumulator batteries (main and standby) are to be provided with the capacity of each sufficient for fire detection and alarm system functioning for at least 3 days without recharging.

7.4.4 The fire detection and alarm system operating on the principle of sampling the air in protected spaces for its delivery into the receiving alarm device, and its fans are to be fed by separate feeders from the main source of electrical power and from the emergency one, or from another source independent of the main source of electrical power.

7.4.5 The design of the receiving device of a fire detection and alarm system, except the smoke one, is to be such that:

.1 any signal or damage to one circuit does not impact normal functioning of other circuits;

.2 the signal of fire indications detection prevails over other signals entering the receiving device and allows to determine the location of the space wherefrom the above signal came;

.3 the circuits of contact-type fire detectors of a fire detection and alarm system operate in breaking. It is allowed to use the contact-type detectors operating in closing provided their contacts are sealed and circuits are monitored for damages detection;

.4 the possibility to monitor its functioning is provided.

7.4.6 The receiving alarm device is to produce the information specified in Table 7.4.6. The visual signal of fire detection is to be so designed that it consists of two indicators (two lamps or a double filament), or provision is to be made for a special device to check the proper condition of signaling lamps. The colour of the visual signal is to meet the requirements of 4.6.5.

Visual signals are to be separate for each type of information. The signals indicating the location of a space or area wherefrom a pulse has come may be common with the signal of fire or damage detection. Visual signals are to operate since the pulse reception till the moment of elimination of their activation cause while the signal specified in item 1 of Table 7.4.6 is to function continuously irrespective of the supply source specified in 7.4.3.

7.4.7 If the fire detection signal in the receiving device is ignored within 2 min, a fire alarm is automatically to be activated in machinery, accommodation and other spaces where crew members may be present.

Table 7.4.6

Nos	Alarm on operating conditions and faults	Signal of using temperature fire detection and alarm system	Signal of using systems with air delivery from protected spaces into receiving alarm device
1	Device operation	Visual	Visual
2	Supply form emergency source	Visual	Visual
3	Fire indications and location of space or area where they are detected	Audible Visual	Audible Visual
4	No draught in detection chamber	-	Audible Visual
5	No draught in pipelines	-	Audible Visual
6	Discontinuity in detector circuits	Audible Visual	Audible Visual
7	Location of supply circuit damages	Visual	Visual
8	Open line condition (recommended)	Visual	-
9	Loss of supply	Audible Visual	Audible Visual

7.5 WARNING ALARM ON FIRE-SMOTHERING SYSTEM RELEASE

7.5.1 A warning alarm system is to meet the requirements of Section 5, Part V "Fire Protection".

7.5.2 The supply of an alarm system is to be effected from the ship's mains and accumulator battery with a capacity sufficient for 30 min operation. In so doing, provision is to be made for the device automatically switching over alarm supply circuits to the accumulator battery with the voltage loss in the ship's mains.

8 PROTECTIVE DEVICES

8.1 GENERAL

8.1.1 Outgoing circuits of switchboards are to be protected against short circuits and overloads with devices installed at the start of each circuit. Protection of switchboard supply circuits against overloads is not required if the consumers fed from that switchboard are provided with individual overload protection devices, and the cable of the switchboard supply circuit is determined for the maximum operating current.

8.1.2 Protective devices are to be matched with the characteristics of the equipment under protection so that they may be activated at impermissible overloads.

8.1.3 The electric protection system is to be selective in the zone of both overload currents and short-circuit currents. In this case, the protection is to be designed so that its activation does not adversely affect the reliable functioning of the ship's generating plant and the supply of essential services.

Short-circuit and overload protection devices are not to be activated at starting currents of electrical equipment under protection.

8.1.4 Overload protection is to be installed in:

.1 not less than one phase or a positive pole in a two-wire system;

.2 not less than two phases in an isolated three-wire three-phase current system;

.3 all phases in a three-phase four-wire system.

8.1.5 Short-circuit protection is to be fitted in each isolated pole of a direct-current system, as well as in each phase of an alternating current system.

Current settings of short-circuit protection devices are to comply with at least 200 per cent of the rated current for the electrical equipment under protection. Protection activation may be without a time delay or with that necessary for proper selectivity.

The short-circuit current protection device may be used for protection of both the very consumer and its supply cable.

8.1.6 Where the cables of a reduced cross-sectional area are used in some lengths of a supply circuit, additional protection is to be provided for each of such cables unless the protective device fitted above is capable of protecting the cable of the reduced cross-sectional area.

8.1.7 Protective devices preventing the possibility of immediate repeated switching after protection activation are not to be used in emergency switchboard supply circuits, as well as in emergency consumers supply circuits.

8.1.8 A protection device is not to be fitted in the equalizer lead of direct-current generators.

8.2 GENERATORS PROTECTION

8.2.1 Overload and short-circuit protection devices are to be fitted for generators not intended for running in parallel; in this case, fuses may be used for generators rated under 50 kW (kVA) as protection devices.

8.2.2 Generators intended for running in parallel are to be fitted with at least the following protection devices:

.1 against overloads;

.2 against short circuits;

.3 against a reverse current or reverse power;

.4 against a minimal voltage.

It is recommended to use for generators such overload protection devices which are provided with an audible and visual alarm on overload operating with a time delay up to 15 min for loads within 100 per cent to 110 per cent of the rated current, and capable of disconnecting generators with a time delay corresponding to the thermal time constant of the generator under protection for loads within 110 per cent to 150 per cent of the rated current. It is recommended that the time delay of a protection setting for 150 per cent of the rated current of the generator does not exceed 2 min for alternating-current generators and 15 s for direct-current generators. An overload exceeding 150 per cent of the rated current of the generator may be allowed where it is required by operating conditions and allowed by the generator design.

Overload protection settings and time delays are to be matched with the overload characteristics of the prime mover of a generator in such a manner that the prime mover may develop the necessary output within the time delay adopted. Protective devices preventing the immediate restarting of the generator are not to be used for generator overload protection.

8.2.3 Devices automatically and selectively disconnecting non-essential services at the generators overload are to be provided. The disconnection of those services may be carried out in one or several steps depending on the generator capacity overload.

This requirement may be ignored for ships with the electrical installation of sufficient power reserve if approved by the Register.

8.2.4 The protection of generators, intended for running in parallel, against a reverse current or reverse power is to be matched with the characteristics of a prime mover. The limits of settings for the protection types specified are to comply with those given in Table 8.2.4.

Table 8.2.4

Current	Limits of reverse-current or reverse-power protection settings depending on prime mover of generator	
	Turbine	Internal combustion engine
Alternating	2 per cent to 6 per cent of the generator rated output, in kW	8 per cent to 15 per cent of the generator rated output, in kW
Direct	2 per cent to 15 per cent of the generator rated current, in A	2 per cent to 15 per cent of the generator rated current, in A

Reverse-current protection for direct-current generators is to be installed in the pole opposite to that in which an equalizer lead is connected. With the reduction by 50 per cent of the voltage applied, reverse-power or reverse-current protection is to be capable of operation although the value of the reverse current or reverse power may alter.

8.2.5 Undervoltage protection is to ensure the possibility of the reliable connection of generators to busbars at a voltage of 85 per cent and more of the rated one, and to prevent the possibility of a generator-to-busbars connection at a voltage less than 35 per cent of the rated one, as well as to disconnect the generators with the reduction of the voltage across their terminals within 70 per cent to 35 per cent of the rated value.

Undervoltage protection is to operate with a time delay for the disconnection of generators from busbars at voltage reduction and without a time delay when the connection of a generator to busbars is attempted prior to reaching the above minimal voltage.

8.2.6 Where a turbine-driven direct-current generator is intended for running in parallel, provision is to be made for tripping the generator circuit breaker with the activation of a turbine overspeed governor.

8.2.7 Fuses as protection devices for semiconductor elements may be used in generator excitation systems.

8.3 ELECTRIC MOTORS PROTECTION

8.3.1 Outgoing feeders from switchboards supplying electric motors rated at over 0,5 kW are to be provided with short-circuit current and overloads protection devices, as well as with a no-voltage protection device where an automatic restarting of the electric motor is not required. The overload and no-voltage protection devices may be fitted in starting apparatus of electric motors.

8.3.2 The overload protection devices for continuously running electric motors are to disconnect the motor under protection within the range from 105 per cent to 125 per cent of the rated current.

Overload protection of electric motors may be replaced by a visual and audible alarm in each case subject to special consideration by the Register.

8.3.3 Overload protection devices disconnecting electric drives of fire pumps with activation of thermal electric and temperature relays are not to be used in supply circuits of electric drives of fire pumps.

The activation of thermal electric or temperature relays at overload is to actuate a visual and audible alarm on the electric drive overload.

8.4 STEERING GEAR PROTECTION

8.4.1 A short-circuit current protection device only is to be provided for electric motors and control systems of electric or electro-hydraulic steering gear. A visual and audible alarm on the motor overload and the failure of any phase of the feeder supplying the motor is to be fitted.

If bimetallic strip relays to alarm the electric motor overload are provided, they are to be selected for the 0,7-fold rated current of the electric motor.

The protection device of a steering gear control circuit is, at least, to comply with the two-fold maximum current of the control circuit.

8.4.2 Circuit breakers protecting direct-current motors against a short-circuit are to be set for release without a time delay at a current not less than 30 per cent and not more than 400 per cent of the rated current of the motor under protection, and alternating-current motors, for release without a time delay at a current not less than 125 per cent of the peak starting current of the motor under protection. Where fuses are used as such protection, the rated current for the fuse links is to be one grade of rating higher than it follows from the conditions specified for starting currents of the electric motor.

8.4.3 Provision is to be made for overload and short-circuit current protection for electric motors of the drives for active means of the ship's steering.

Overload protection devices of the above motors are to be fitted with a visual and audible alarm on overload and to disconnect the electric motor in the overload range specified in 8.3.2. The short-circuit current protection is to comply with the requirements of 8.4.2.

8.5 TRANSFORMERS PROTECTION

8.5.1 Short-circuit and overload protection devices are to be installed on the supply feeders of transformer primaries. The transformers rated up to 6,3 kVA may be protected with fuses only. Transformers overload protection may be replaced by an audible and visual alarm in each case subject to special consideration by the Register.

No overload protection and alarm are required for voltage transformers and supply transformers of control circuits.

8.5.2 Where transformers are intended for running in parallel, switches are to be installed to disconnect their primaries and secondaries, but not necessarily at the same time. If such transformers are supplied from different main switchboard sections, which may be isolated in service, provision is to be made for an interlock to prevent their parallel operation when the main switchboard sections are isolated.

8.5.3 The switching-over of instrument current transformers is to be so arranged as to prevent the possibility of their secondaries being an open circuit.

8.6 ACCUMULATOR BATTERIES PROTECTION

8.6.1 Short-circuit current protection devices for accumulator batteries except those intended for starting internal combustion engines are to be provided.

8.6.2 Each battery-charging system is to be protected against battery discharge due to the drop or loss of the charger output voltage.

8.6.3 For accumulator batteries intended for starting internal combustion engines, it is recommended to fit disconnectors at the start of the circuit on the accumulator side to disconnect accumulator batteries from services (the disconnector may be fitted in one pole).

8.7 PROTECTION OF PILOT LAMPS, VOLTMETERS, CAPACITORS AND VOLTAGE COILS

8.7.1 Pilot lamps, as well as measuring and recording instruments are to be provided with switch short-circuit protection or devices limiting a short-circuit current. Pilot lamps may have no short-circuit protection of their own nor devices limiting a short-circuit current provided the following conditions are met:

.1 the lamps are enclosed together with the device;

.2 the lamps are supplied from the circuits inside the enclosure of the device;

.3 the device circuit protection is designed for current not exceeding 25A;

.4 a fault in the lamp circuit cannot result in the interruption of an essential service operation.

Short-circuit protection devices or devices limiting a short-circuit current are to be located as close as possible to the terminals of the device under protection on the supply side.

8.7.2 Radio interference suppression capacitors fitted in the circuits of main and emergency switchboards, generators and essential electrical installations are to be protected against short-circuit currents.

8.7.3 The voltage coils of apparatus and devices for control and protection are to be protected against a short circuit, but may have no protection of their own provided the following conditions are met:

.1 the coils are enclosed with the device, are under overall protection and belong to the control system of one device;

.2 the coils are supplied from the device circuit which protection is designed for a current not more than 25 A.

8.8 PROTECTION OF POWER SEMICONDUCTOR UNITS

8.8.1 Power semiconductor units are to be protected against internal and external overvoltages.

8.8.2 Semiconductor element blocks are to be protected against a short circuit.

Diodes and thyristors protection is to be isolated from the protective circuit of loading.

8.8.3 Where only one consumer is available, it is allowed to have common protection for diode and thyristor blocks, and power circuits.

9 EMERGENCY ELECTRICAL INSTALLATIONS

9.1 GENERAL

9.1.1 Every self-propelled ship is to be provided with an independent emergency source of electrical power. If accumulator batteries on board the ship are the main source or the source being part of the main source of electrical power, these batteries may also be considered as the emergency source of electrical power. In this case, the capacity and location of the accumulator battery are to meet the requirements imposed on the emergency source. The installation of the emergency source on non-self-propelled ships is subject to special consideration by the Register.

9.1.2 A diesel-generator or an accumulator battery may be used as an emergency source of power.

9.1.3 The capacity of an emergency source is to be sufficient for the simultaneous supply of all services essential for navigation safety in case of emergency.

9.1.4 Provision is to be made for a possibility of testing the whole emergency installation including automatic starting devices of a diesel-generator.

9.1.5 A possibility to monitor discharging of any accumulator battery being an emergency source is to be provided in the main machinery control room or on the main switchboard.

9.1.6 Emergency sources of electrical power are to be protected against short-circuits only. Where a diesel-generator is the emergency source, a visual and audible alarm on the generator overload is to be provided in the main machinery control room or watchkeeping location.

9.2 SPACES FOR EMERGENCY SOURCES OF ELECTRICAL POWER

9.2.1 Spaces for emergency sources of electrical power and their transformers (if any), emergency temporary sources of power, emergency and emergency lighting switchboards are to be located above the uppermost continuous deck outside machinery spaces and abaft the collision bulkhead. These spaces on ships covered by the requirements of Part IV "Stability, Subdivision and Freeboard" are also to be located, as a minimum, at least 300 mm above the deepest damage waterline. Exits from the above spaces are to be readily accessible and lead directly to the open deck on which the emergency source of electrical power is located.

On ships (other than passenger ships) having an accumulator battery as a main source of electrical power according to 9.1.1, such a battery may be installed in the engine room but its upper part is to be, at least, above the deepest damage waterline.

9.2.2 The arrangement of emergency sources and pertinent transformers (if any), of temporary sources of electrical power, of emergency and emergency lighting switchboards with regard to main sources of electrical power and pertinent transformers, and to the main switchboard is to be such that a fire or another emergency in the space of the main source of electrical power, of pertinent transformers, the main switchboard and also in any machinery space of category A do not affect the supply, control and distribution of electrical power form the emergency source.

9.2.3 Spaces for emergency sources of electrical power, pertinent transformers, temporary sources of electrical power, emergency and emergency lighting switchboard are not to be, as far as practicable, adjacent to machinery and boiler spaces and to spaces for the main source of electrical power, pertinent transformers and the main switchboard. Where they are adjacent, the decks and bulkheads separating them are to be designed in accordance with the requirements of Part V "Fire Protection" relating to control stations.

9.2.4 The emergency switchboard is to be located as close as practicable to the emergency source of electrical power.

9.2.5 Where a diesel-generator is an emergency source of electrical power, an emergency switchboard is to be installed in one space with the diesel-generator except the case when such arrangement adversely affects the switchboard operation. All starting and charging devices as well as starter accumulator batteries for the emergency unit starting are also to be located in this space provided the requirements of 13.2 are met.

9.2.6 The emergency generator set space is to be provided with heating appliances to keep up the temperature in the space appropriate to the trouble-free starting of the emergency set, and with ventilation in accordance with 11.4.3, Part VII "Systems and Piping".

9.2.7 Where the accumulator battery is the emergency source of electrical power, this battery and the emergency switchboard are to be installed in separate spaces. The requirements for accumulator battery rooms are given in 13.2.

9.3 EMERGENCY SOURCES OF ELECTRICAL POWER ON CARGO SHIPS

9.3.1 Where a diesel-generator is an emergency source of electrical power, it is to ensure the supply of the following services:

.1 emergency lighting of:

all corridors, stairways and exits from service spaces, passenger lift cars and trunks, signs of exits to the boat deck;

muster and embarkation stations on deck and overboard;

machinery spaces and their exits;

all control stations, as well as of the main and emergency switchboards;

spaces for the emergency source of electrical power;

wheelhouse;

chartroom and radioroom;

stowage places for emergency materials, fire-fighting inventory, fireman's outfit and places where manual fire alarms are fitted;

steering gear compartment;

places at fire and sprinkler pumps, emergency bilge pump and places of starting devices for the machinery;

.2 navigation lights, lanterns of "Ship not under command" signal and other lanterns required in Section 12 "Signal Means", Part III "Equipment, Arrangements and Outfit";

.3 internal communication and announcing means and a general alarm system;

.4 radio and navigational equipment in accordance with the requirements of Part XI "Radio Equipment" and Part XII "Navigational Equipment";

.5 fire detection and alarm systems;

.6 daytime signaling lamps, sound signal means (whistles, gongs, etc.), manual summoning and other signals required under emergency conditions;

.7 one of fire pumps (if fed from an emergency source) and electrical equipment ensuring the operation of foam generators specified in Part V "Fire Protection";

.8 electric drives of watertight and fire doors;

.9 other systems which operation will be recognized by the Register as necessary to ensure safety of the ship and people onboard.

The period of time during which the supply of the specified services is to be ensured, is subject in each case to special consideration by the Register, but it is not to be less than 3 hours.

9.3.2 An emergency diesel-generator is to be:

.1 driven by an internal combustion engine (refer to 2.2.4, Part VIII "Machinery");

.2 automatically started with the loss of voltage in the mains and automatically connected on the busbars of an emergency switchboard. The total time of starting and load takeover by the generator is not to exceed 30 s;

.3 if the automatic start of the emergency unit according to 9.3.2.2 is not ensured within 30 s, provision is to be made for an emergency temporary source of electrical power which is to immediately start with deenergizing and feed services specified in 9.3.4.

9.3.3 Where an accumulator battery is an emergency source of electrical power, it is to:

.1 operate without recharging at voltage variations across the terminals within 12 per cent of the rated voltage during the whole discharge period;

.2 be automatically connected on emergency switchboard busbars with the loss of voltage in the mains and, at least, feed the services specified in 9.3.4.

9.3.4 The capacity of the battery being a temporary source of electrical power is to be sufficient to ensure the supply during 30 min of the following services:

.1 lighting and essential navigation lights according to 9.3.1.1 and 9.3.1.2.

The locations of emergency lighting are subject to special consideration by the Register;

.2 all internal communication and announcing means required under emergency conditions;

.3 general alarm system, fire detection and alarm system, and warning system on starting a fire-smothering system;

.4 daytime signaling lamps, sound signal means (whistles, gongs, etc.);

.5 closing gear of watertight doors, their position indicators and signals warning of their closure.

The services listed in 9.3.4.2, 9.3.4.3 and 9.3.4.4 may not be supplied from the temporary source if they have their own accumulator batteries feeding them within the time period required.

9.4 DISTRIBUTION OF ELECTRICAL POWER FROM EMERGENCY SOURCES

9.4.1 Under normal service conditions the emergency switchboard is to be supplied from the main switchboard. The supply feeder is to be provided with overload and short-circuit protection devices fitted in the main switchboard.

The emergency switchboard is to be fitted with a breaker, which switches off automatically with the loss of voltage on the main switchboard busbars.

Where the main switchboard is fed from the emergency one, the automatic breaker on the emergency switchboard is to be provided, at least, with short-circuit protection devices.

9.4.2 Where provision is made for an emergency diesel-generator to supply non-emergency consumers in exceptional cases and for the short period of time, the appropriate measures are to be taken to ensure the operation of emergency arrangements under all emergency conditions, as well as the automatic disconnection, wherever necessary, of non-emergency consumers from the emergency switchboard to ensure the supply of emergency consumers.

9.4.3 The consumers specified in 9.3.1 and 19.1.3 are to be supplied by separate feeders from the busbars of the emergency switchboard fitted with the relevant switchgear and protection equipment. It is allowed to supply the consumers specified in 9.3.1.2 to 9.3.1.6 and 19.1.3.1.2 to 19.1.3.1.6 from the ship's control console located in the wheelhouse and fed in accordance with 4.5.2.

9.4.4 The cables feeding emergency consumers are to be so laid that flooding of consumers below the bulkhead deck may not discontinue the supply of other consumers located above that deck.

9.4.5 Distribution gear of emergency services are to be located above the bulkhead deck.

9.5 STARTING ARRANGEMENTS FOR EMERGENCY DIESEL-GENERATORS

9.5.1 The following arrangements may be used as starting arrangements for diesel-generators:

.1 electric starter with its own accumulator battery and a charging device;

.2 compressed air system with its own independent air receiver;

.3 hydraulic starting system;

.4 manual starting arrangements: starting handle for manual engine cranking, inertia starters, manually charged hydraulic accumulators and powder charge cartridges.

9.5.2 Every automatically-started emergency diesel-generator is to be fitted with the starting arrangement of the approved type with a store of energy sufficient for at least three consecutive starts. In addition, the second source of power is to be installed to ensure additionally three starts within 30 min unless a manual starting arrangement is provided.

9.5.3 Where automatic starting of an emergency diesel-generator is not required, manual starting with one of the starters specified in 9.5.1.4 is allowed.

Where manual starting is impracticable, starters are to meet the requirements of 9.5.2.

9.5.4 The supply of charging devices for accumulator batteries and electric drives of machinery, maintaining compressed-air starting systems or hydraulic systems of the emergency diesel-generator starting is to be effected from the emergency switchboard by separate feeders.

10 ELECTRICAL MACHINES

10.1 GENERAL

10.1.1 Alternating-current generators along with their automatic voltage regulation systems are to sustain at least a three-fold current within 1 s under steady short-circuit conditions.

10.1.2 Generators of electric propulsion plants and electric propulsion motors, and also other machines, if justified, are to be heated for maintaining their temperature at least 3 ºC above the ambient air temperature.

10.1.3 Shaft generators mounted in the shafting of the main machinery installation are to have split stators and bearing shields if the shaft arrangement prevents the possibility of the stator displacement in the direction opposite to the rotor. Such shaft generators are to have an air gap preventing a mechanical contact between the rotor and stator under the most unfavourable service conditions.

10.1.4 Rotors and armatures of alternating and direct-current machines are to withstand within 2 min without damage and permanent set the following increased rotation speeds:

.1 independently-driven generators, rotary converters, electric couplings and brakes — 120 per cent of the rated rotation speed, but at least by 3 per cent more than the maximum rotation speed in a transient process; main machinery-driven generators — 125 per cent of the rated rotation speed;

.2 series-wound motors: 120 per cent of the maximum permissible rotation speed shown in the rating plate, but not less than 150 per cent of the rated rotation speed;

.3 all other electric motors except the above — 120 per cent of the maximum no-load rotation speed.

10.1.5 Where the machine is so designed that its bottom after installation on board the ship is below the plating, the air intake for its ventilation is not to be effected at the bottom of the machine.

10.1.6 Interference-suppressing capacitors in direct-current machines are to be connected to the armature terminals. The interference-suppressing capacitors on generators are to be provided with built-in fuses.

10.1.7 The terminals are to be readily accessible and their dimensions are to meet the cross-section of the cable connected. The terminals are to be clearly marked.

10.2 SLIP RINGS, COMMUTATORS AND BRUSHES

10.2.1 Commutators, slip rings and, where possible, windings are to be readily accessible for inspection, maintenance and repair.

The possibility of checking an air gap in machines with plain bearings is to be provided.

10.2.2 The permissible wear of commutator segments or slip rings is to be indicated on their face side. Its value is to be assumed equal to at least 20 per cent of the commutators or slip rings height.

10.2.3 For armatures over 1000 kg in mass provision is to be made to allow reconditioning of a commutator without removal of the armature from a machine.

10.2.4 A flexible copper conductor is to be used for the current drawing from brushes. The use of brush holder springs for this purpose is not allowed.

10.2.5 The brushes position in direct-current machines is to be clearly and indelibly marked. Carbon brushes are to comply with the material of slip rings or commutators and commutation conditions.

10.2.6 Commutator machines are to operate practically without sparking at any load from zero to the rated value. No sparking is allowed at specified overloads, reversals and startups to such an extent as to cause brush or commutator damages.

10.3 BEARINGS

10.3.1 The bearings design is to be such as to prevent the possibility of oil splashing or leaking along the shaft and its penetration onto the machine windings or live parts.

10.3.2 The casings of plain bearings are to be fitted with a hole for excessive lubricating oil drain and with a lid in their upper part. The machines rated 100 kVA and over are to be provided with an oil level indicator.

10.3.3 A pressure lubrication system is to incorporate pressure indicators for oil entering the bearing.

10.3.4 For electric propulsion machinery, and also, when justified, for other machinery measures are to be taken to prevent the flow of shaft currents through plain bearings.

10.3.5 The bearings of generators driven by belts or chains from the ship's main machinery installation are to be so designed that the effect of lateral forces is taken into account.

10.4 TEMPERATURE DETECTORS

10.4.1 Built-in temperature detectors are recommended to be fitted into electric motors operating under short-term or intermittent conditions.

10.4.2 Overload protection for the electric motors of windlass drives is recommended as built-in temperature detectors so selected that the protection system disconnects the electric motor with the rise of the temperature permissible for the insulation used, by more than 30 per cent.

Detector terminals are to be located so as to be readily accessible.

10.5 OVERLOADING

10.5.1 Generators are to be so designed that after heating up to the steady-state temperature corresponding to the rated load they may withstand overcurrent in accordance with Table 10.5.1.

Table 10.5.1

Generator type	Overcurrent, in per cent	Overload duration, in s
Alternating-current	50	120
Direct-current	50	15

10.5.2 Electric motors are to be so designed that they may develop, without stopping or sudden rotation speed changes, the increased torques specified in Table 10.5.2.

Table 10.5.2

Nos	Motor type	Overload in torque, in per cent	Overload duration, in s	Test conditions
1	Synchronous, and also squirrel-cage motors with starting current not less than 4,5 times the rated current	50	15	Frequency, voltage and excitation to be maintained at rated levels
2	Asynchronous motors for continuous operation	60	15	Frequency and voltage to be maintained at rated levels
3	Motors specified in item 2 but for short-time operation with variable load	100	15	Ditto
4	Direct-current motors	50	15	Voltage to be maintained at rated levels

10.6 ALTERNATING-CURRENT GENERATORS

10.6.1 General.

10.6.1.1 Every alternating-current generator is to have a separate independent automatic voltage regulation system.

10.6.1.2 Damages in a voltage regulation system of generators are not to cause across their terminals the voltages exceeding by more than 6 per cent the rated values for lengthy processes and 20 per cent, for processes lasting up to 1,5 s.

10.6.1.3 Alternating-current generators are to possess sufficient excitation capacity to maintain the rated voltage with an accuracy of 10 per cent during 2 min at generator overcurrent equal to 150 per cent of the rated value and at a power factor 0,6.

10.6.2 Voltage regulation.

10.6.2.1 Alternating-current generators are to be fitted with an automatic voltage regulation system, ensuring maintenance of voltage within 2,5 per cent (3,5 per cent for emergency generators) of the rated value with the load change from zero to the rated load value at the rated power factor. The rotation speed therewith is to be within the range specified in 2.11.3, Part VIII "Machinery".

10.6.2.2 A sudden change in the balanced load of a generator running at the rated rotation speed and voltage under given current and power factor conditions is not to result in the drop of voltage below 85 per cent or its rise above 120 per cent of the rated value. Thereafter the generator voltage is to be restored within not more than 1,5 s to ±3 per cent of the rated value. These values for emergency sets may be increased, respectively, up to 5 s and ±4 per cent of the rated voltage.

If precise data on the peak sudden load applied to the generator under load is unavailable, these may be assumed equal to a load of 60 per cent of the rated current at a power factor of 0,4 or less which comes on at no-load run and then is thrown off. The rotation speed therewith is to be within the range specified in 2.11.3, Part VIII "Machinery".

10.7 DIRECT-CURRENT GENERATORS

10.7.1 General.

Shunt-wound direct-current generators are to be fitted with automatic voltage regulators. When an accumulator battery is floating on a generator, voltage regulators are to ensure accumulator batteries charging within the whole load range excluding their recharging.

10.7.2 Voltage regulation.

10.7.2.1 Voltage regulators of compound-wound direct-current generators are to ensure the possibility of reducing a no-load voltage in a cold condition by not less than 10 per cent below the rated generator voltage subject to rotation speed increase at no-load.

10.7.2.2 Manual voltage regulators are to be so designed that voltage increases with their controls rotated clockwise.

10.7.2.3 Voltage regulators of shunt-wound direct-current generators are to be so designed that with excitation removal the field winding is closed to a discharge resistor circuit.

10.7.2.4 Compound-wound direct-current generators are to be provided with independent devices to regulate voltage within a tolerance of ±1 per cent for generators rated up to 100 kW, and within ±0,5 per cent for the ones rated over 100 kW. The above limits are to be maintained in cold and hot conditions, as well as under any load within the operating load range of generators.

10.7.2.5 Direct-current sets comprising compound-wound generators are to have such external characteristics that the hot generator voltage set to the rated value with an accuracy of +1 per cent at the 20 per cent load does not vary at the full load by more than + 1,5 per cent for generators rated at 50 kW and over, and also by more than +2,5 per cent for generators of lower output.

Voltage variations in a compound-wound generator running at 20 per cent to 100 per cent of the rated load are not to exceed the following values:

.1 +3 per cent for generators rated at 50 kW and over;

.2 +4 per cent for generators rated over 15 kW, but less than 50 kW;

.3 +5 per cent for generators rated at 15 kW and less.

10.7.2.6 Direct-current sets comprising shunt-wound generators are to have such external generator characteristics and automatic voltage regulators that the voltage is maintained with an accuracy of +2,5 per cent of the rated value at load variations from zero to the rated one.

10.8 ELECTROMAGNETIC BRAKES

10.8.1 The brake is to operate with the loss of voltage in the brake-operating coil.

10.8.2 A 30 per cent voltage drop below the rated value is not to cause a hot brake to operate.

10.8.3 Electromagnetic brakes are to make possible the manual release.

10.8.4 Electromagnetic brakes are to be fitted with at least two pressure springs.

10.8.5 Shunt field windings of a compound-wound electromagnetic brake are to be such that they are capable of holding the brake released even when the series winding carries no current.

10.8.6 Shunt field windings of brakes are to be so made or protected that they can be safe from damage at overvoltages such as occur when they are being disconnected.

11 TRANSFORMERS

11.1 GENERAL

11.1.1 Dry-type transformers are to be used on ships. The use and installation of other type transformers are subject in each case to special consideration by the Register.

11.1.2 Transformers windings for primary and secondary voltages are to be electrically isolated.

11.2 OVERLOAD, VOLTAGE VARIATION AND PARALLEL OPERATION

11.2.1 Transformers are to bear 10 per cent overloads for 1 hour, as well as 50 per cent ones for 5 min.

11.2.2 Voltage variations at an active load within the idle running-rated load range are not to exceed 5 per cent for transformers rated up to 6,3 kVA per phase and 2,5 per cent for transformers of higher rating.

11.2.3 Transformers intended for parallel operation are to have the same winding connection groups and transformation ratios, and their short-circuit voltages are to be such that any transformer loading does not deviate from the value corresponding to the proportional part of each transformer output by more than 10 per cent of the rated current for a given transformer.

11.2.4 The rated output of the smallest transformer in parallel operation is not to be less than 0,5 the rated output of the largest transformer.

12 POWER SEMICONDUCTOR UNITS

12.1 GENERAL

12.1.1 Semiconductor elements of silicone type are to be used in power semiconductor units.

The use of other type elements is allowed on special agreement with the Register.

12.1.2 In order to prevent the formation of condensate, the units with semiconductor devices, with dissipated power is over 500W, are to be provided with heating to maintain a temperature by at least 3°C above the ambient air temperature.

12.1.3 Power semiconductor units are to be provided with air cooling (natural or forced).

The use of liquid cooling is subject in each case to special consideration by the Register.

12.1.4 The protection reducing or disconnecting the load if cooling is switched off, is to be provided for power semiconductor units with forced cooling.

Provision is to be made for a visual and audible alarm on the excess of the maximum permissible temperature of a cooling medium at the system outlet prior to protection activation.

12.2 PERMISSIBLE PARAMETERS OF VOLTAGE DISTORTION

12.2.1 The nonlinear distortion factor K_u for the ship's mains depending upon the operation of power semiconductor units is not to exceed 10 per cent.

The use of power semiconductor units initiating the distortion of a sine voltage curve over 10 per cent is subject in each case to special consideration by the Register. The nonlinear distortion factor is to be determined by the Formula (2.2.1.3).

12.2.2 The factor of maximum relative deviation of the instantaneous voltage value from the first harmonic value is not to exceed 30 per cent. The factor U_W is to be determined by the following formula:

$$\Delta U_W = \Delta U_M / \sqrt{2U_1} \quad (12.2.2)$$

where ΔU_M = maximum deviation value;
U_1 = effective value of the first harmonic of voltage.

12.3 CONTROL AND ALARM SYSTEMS

12.3.1 Power semiconductor units are to be provided with a visual alarm to indicate a closed and open state of power and control circuits.

12.3.2 The power section of semiconductor units is to be electrically isolated from a control system.

12.3.3 The long-term current deviation in parallel branches of semiconductor units is not to exceed 10 per cent of an average current.

12.3.4 The operation of power semiconductor units is not to be upset when any valve fails. If a load on particular valves exceeds permissible levels, it is to be automatically reduced.

A visual and audible alarm is to be activated when any valve fails.

12.4 MEASURING INSTRUMENTS

12.4.1 Power semiconductor units are to be fitted with measuring instruments in accordance with their purpose.

12.4.2 The scales of measuring instruments of power semiconductor units are to have maximum permissible parameter values marked. The maximum permissible temperature is to be clearly marked on the scale of an instrument for measuring the cooling air temperature at forced cooling.

13 ACCUMULATOR BATTERIES

13.1 GENERAL

13.1.1 Accumulator batteries are to be made so that the loss of fully charged accumulator batteries capacity due to self-discharge after 28 days out of operation at a temperature of (20+5) °C does not exceed 30 per cent of the rated capacity for acid batteries and 25 per cent, for alkaline ones.

13.1.2 Accumulator battery containers and closures are to be made so as to prevent electrolyte pouring out and splashing when the container is inclined 40° to the vertical in any direction. Closures are to be made of the material, durable and resistant to electrolyte effect. Closure design is to allow no build-up of excess gas pressure inside the accumulator battery.

13.1.3 The mastics used are not to change their properties and to deteriorate at ambient temperature variations in a range -30 to $+60$ °C.

13.1.4 Materials used for accumulator battery cases manufacture are to be resistant to electrolyte effect. Individual cells located in cases are to be secured so as to exclude their mutual shifting.

13.2 ARRANGEMENT OF ACCUMULATOR BATTERIES

13.2.1 Batteries for voltage above the safety one, as well as batteries having a charging capacity over 2 kW calculated at the maximum charging current and the rated voltage are to be located in special battery rooms accessible from the deck, or in suitable boxes placed on the deck. Batteries of 0,2 to 2 kW charging capacity may be installed in boxes or cabinets located inside the ship's hull.

On ships with electrical installation of low power, except passenger ships, the above batteries may be installed in the machinery space in such a way that their upper part is at least above the margin line in case of the ship's flooding.

Accumulator batteries intended for the electric starting of internal combustion engines, except emergency units, may be installed in machinery spaces in special boxes or cabinets having sufficient ventilation.

Batteries of a charging capacity under 0,2 kW may be installed in any space, except accommodation ones, provided they are protected from exposure to water and mechanical damages, and have no harmful effect upon the adjacent equipment.

Arrangement of accumulator batteries in cargo holds is not allowed.

13.2.2 Acid and alkaline batteries are not to be located in one space or box. Containers and instruments for batteries with different electrolytes are to be installed separately.

13.2.3 The interior of spaces or boxes for accumulators, as well as all structural parts potentially subjected to adverse effects of electrolyte or gas are to be suitably protected.

13.2.4 Accumulator batteries, as well as individual cells, are to be properly secured.

If they are installed on shelves in two or more tiers, all shelves are to have at the front and rear a clearance of at least 50 mm for air circulation, and a distance from the deck to the plugs of upper tier cells is not to exceed 1500 mm.

13.2.5 While installing accumulator batteries or individual accumulators (cells), provision is to be made for pads and spacers between them to ensure a clearance of at least 15 mm on all sides for air circulation.

13.2.6 Warning notices about the explosion hazard are to be made on the doors leading to the accumulator battery room or nearby, and also on the boxes containing accumulator batteries.

13.3 HEATING

13.3.1 Accumulator battery rooms and boxes wherein the temperature in service may fall below 5 °C are to be heated. Heating may be effected at the cost of adjacent spaces heat, and also with water or steam radiators located inside the accumulator battery rooms.

13.3.2 The heating system valves are to be located outside accumulator battery rooms.

13.3.3 The shipboard air conditioning system is not to be used for heating accumulator battery rooms.

13.4 VENTILATION

13.4.1 Accumulator battery rooms and boxes are to have adequate ventilation to prevent potential generation and accumulation of explosive air-gas mixtures.

Ventilation system is to meet the requirements of Part VII "Systems and Piping".

13.4.2 Accumulator battery rooms provided with mechanical ventilation are to have devices preventing the possibility of accumulators charging prior to ventilation switching-on.

Charging is to be automatically discontinued when fans stop.

13.5 CHARGING OF ACCUMULATOR BATTERIES

13.5.1 Provision is to be made for a charging device designed for charging accumulator batteries of essential services during 8 hours.

Where an additional battery instead of the one being charged in used, the charging time may exceed 8 hours.

13.5.2 A charging device is to provide a possibility of measuring the voltage across battery terminals and charging current, as well as discharge current for emergency sources of electrical power.

13.5.3 Facilities to charge the accumulators of portable accumulator-fed lanterns or spare accumulator-fed navigation lights on ships fitted with such lights are to be provided.

13.6 INSTALLATION OF ELECTRICAL EQUIPMENT IN ACCUMULATOR BATTERY ROOMS

13.6.1 Except for safe-type lighting fixtures and cables terminated at accumulator batteries and lighting fixtures, no other electrical equipment is to be installed in accumulator battery rooms.

The cables terminated at accumulator batteries and lighting fixtures may be laid openly provided they have metal armour or braid covered with non-metal sheathing, and that armour or braid is securely earthed at both ends.

13.7 ELECTRICAL STARTERS FOR INTERNAL COMBUSTION ENGINES

13.7.1 Number of starter batteries.

13.7.1.1 The ship equipped with an electrically-started internal combustion engine is to be provided with a stationary separate accumulator battery.

The ship equipped with two or more electrically-started internal combustion engines is to have at least two common batteries for starting all the engines.

In this case, provision is to be made for a permanent switching system ensuring the possibility to use any of those batteries for starting any engine from the group supplied by that battery.

13.7.2 Battery characteristics.

13.7.2.1 Each starter battery is to be designed for a discharge current in starter duty corresponding to the maximum current of the most powerful starting electric motor.

13.7.2.2 Each battery capacity is to ensure at least six starts of the internal combustion engine in the ready-for-start condition, and at least three starts of each engine for two or more engines.

13.7.2.3 When calculating batteries capacity provision is to be made for the duration of each start at least 5 s.

13.7.3 Charging facilities.

13.7.3.1 Provision is to be made for a charging device for starter batteries even if the batteries are charged from an attached generator.

The supply of a charging device of starter batteries is to be effected by a separate feeder from the main switchboard.

13.7.3.2 The charging of a starter battery from the attached generator only is allowed on ships with an installation of low power. In this case, provision is to be made for a possibility to charge the batteries, when an internal combustion engine stops, from the shipboard source of electrical power or from an external source of electrical power.

14 ELECTRICAL APPARATUS AND ACCESSORIES

14.1 ELECTRICAL APPARATUS

14.1.1 General.

14.1.1.1 The design of removable contact switches is to be such that contacts may be replaced with standard tools without disassembly of the switch or its basic components.

14.1.1.2 All disconnectors and switches, except those for cabins, are to be provided with mechanical or electrical indicators of a closed contacts position which are located at the place whereof the apparatus is activated by the operator.

14.1.1.3 The positions of controller and pilot controller drums are to be rigidly fixed mechanically, the location in a zero position therewith is to be more rigid than elsewhere.

Controller and pilot controller drums are to be fitted with a scale and an indicator or fixture indicating an on-position.

14.1.1.4 Control apparatus, except those used for continuous regulation, are to be made so that end and intermediate fixed positions are easily sensed at various control stages, and movement beyond the end position is impossible.

14.1.2 Manually-operated apparatus.

14.1.2.1 The direction of manual controls movement for switchgear or control apparatus is to be such that the clock-wise rotation of a handle (handwheel), or the upward or ahead displacement of a handle (lever) corresponds to apparatus closing, electric motor starting, speed increase, voltage rise, etc.

Where hoisting or lowering arrangements are controlled, the clockwise rotation of a handle (handwheel) or displacements of a handle (lever) toward the operator are to correspond to hoisting, and the counter-clockwise rotation or displacement away from to operator, to lowering.

14.1.2.2 The buttons of switches are to be made so that they may not be inadvertenty activated.

14.1.3 Motor-driven apparatus.

14.1.3.1 The driving mechanism of circuit breakers and other switches is to be so designed that contacts remain only in a closed or open position with the loss of supply to the motor drive.

14.1.3.2 An electric motor drive is to ensure reliable closing of an apparatus at variations of the control circuit voltage within 85 per cent to 110 per cent of the rated value, and in case of alternating current, at the frequency deviation within ±5 per cent of the rated one.

14.1.3.3 The drop of the control circuit voltage down to 70 per cent of the rated value is not to result in opening the apparatus contacts, or in reducing the pressure thereof.

14.1.3.4 The design is to provide a possibility to manually control the switch having a motor drive.

14.1.4 Coils.

14.1.4.1 A conductor or shoe is to be attached to the coil winding in a way preventing transfer of forces from the conductor to the coil turns. The taps of voltage coils are to be made of a flexible stranded conductor except those cases when contact terminals are secured directly to the coil frame.

14.1.4.2 The coils of electromagnetic apparatus are to have designations of their characteristics.

14.1.5 Resistor elements.

14.1.5.1 Resistor elements are to be readily replaceable, in sections or as a whole.

14.1.5.2 Resistors are to be arranged and ventilated in a way preventing heating of other devices up to the limits exceeding the permissible values.

14.1.5.3 The joints between resistor elements or between them and terminals are to be effected by welding or by mechanical press-fitting where there is no need to provide their dismantling. It is allowed to use soldering where the temperature at the junction point is below the limit permissible for a solder.

14.1.6 Fuses.

Fuse link housings are to be of the totally enclosed type. Fuse link blowing is not to cause arc ejection to the outside, sparking or other harmful effect upon the adjacent parts.

14.2 ELECTRICAL ACCESSORIES

14.2.1 General.

14.2.1.1 The enclosures of accessories and fittings intended for installation on the open deck, in refrigerated spaces and in other places with elevated humidity are to be made of a material which is corrosion-resistant or properly protected against corrosion and, at least, flame-retardant, or of plastics with appropriate mechanical strength and quality. If steel or aluminium alloys are used, proper anti-corrosive protection is to be provided. Threaded connections and tight-fit mating of articles made of aluminium alloy are not recommended.

14.2.1.2 Insulating articles, to which current-carrying parts are attached, are to be made of materials not evolving electric spark-ignited gases at a temperature up to 500 °C inclusive.

14.2.1.3 Lighting fixtures intended for mounting on or close to combustible materials are to be made in a way preventing their heating above 90 °C.

14.2.2 Lampholders.

14.2.2.1 The design of lampholders with screw caps is to effectively prevent the lamps from getting loose in service.

14.2.2.2 No switches are allowed in lampholders.

14.2.2.3 Every lampholder is to have the rated voltage, and also the maximum permissible current or power marked.

14.2.3 Plug and socket connectors.

14.2.3.1 Pinholes of socket outlets are to be so designed as to ensure permanent pressure in contact with plug pins.

14.2.3.2 Split pin plugs are not allowed. The pins of plugs designed for currents over 10 A are to be cylindrically shaped, solid or hollow.

14.2.3.3 Socket outlets and plugs for voltages exceeding the safety one are to have contacts for connecting earthing conductors of the current consumers cable.

14.2.3.4 Socket outlets are to be so designed that the protection degree is ensured regardless of whether the plug is in or out of the socket outlet.

14.2.3.5 Built-in switches are to be provided for socket outlets rated at over 16 A. Provision is also to be made for interlocking these outlets to prevent a possibility to insert in or withdraw the plug from the outlet when the outlet switch is in an “ON” position.

14.2.3.6 If socket outlets have no interlock, the clearance between contacts in air and across the insulation surface is to be such that no short circuit due to an arc-over is possible when the plug is withdrawn while carrying a load 50 per cent above the rated current at the rated voltage.

14.2.3.7 Socket outlets and plugs are to be so designed that a current-carrying pin cannot be inserted into an earthing pinhole, and the design of outlets intended for connecting motors (devices) which rotation (operation) direction depends on the change of phases or poles sequence is, in addition, to prevent the possibility of the change of this sequence.

When a plug is inserted into a socket outlet, the earthing plug part is to make contact with the earthing part of the socket outlet prior to connecting current-carrying pins.

15 ELECTRICAL COOKING AND HEATING APPLIANCES

15.1 GENERAL

15.1.1 Only stationary-type electrical cooking appliances are allowed for use.

15.1.2 Supply of electrical cooking appliances is to be effected from the main or group switchboards intended for this purpose, and also from lighting switchboards considering the requirements of 6.2.1.

15.1.3 Supporting structural parts of electrical cooking appliances, as well as internal surfaces of enclosures are to be manufactured entirely from non-combustible materials.

15.1.4 A permissible leakage current in a heated condition is not to exceed 1 mA per 1 kW of rated power for any separately switched-on heating element and 10 mA for the appliance as a whole.

15.1.5 Electrical cooking appliances are to be so designed that the temperature of their components to be handled or potentially touched by the personnel does not exceed the values given in Table 15.1.5

Table 15.1.5

Nos	Appliance components	Temperature, in °C
1	Operating handles and other parts to be handled for long periods of time:	
	metallic	55
	non-metallic	65
2	Same, but where a short-time contact is possible:	
	metallic	60
	non-metallic	70
3	Enclosures of electrical heating appliances at an ambient air temperature of 20°C	80
4	Air passing to heated spaces from electrical heating appliances	110

15.2 HEATING APPLIANCES

15.2.1 Electrical heating appliances are to be stationary. They are to be fitted with devices disconnecting supply with the impermissible temperature rise of the appliance enclosure.

15.2.2 Heating appliances are to be installed according to the requirements of 3.2, Part V "Fire Protection".

15.2.3 Where heating and cooking appliances are not provided with built-in disconnecting devices, the last are to be installed in the space wherein these appliances are located. Switches are to disconnect supply across all poles or phases.

15.2.4 The design of electric heaters enclosures is to prevent the possibility of placing any objects upon them.

15.2.5 Stationary heaters rated at 380 V allowed for use in accordance with Table 4.2.2 are to be protected against access to live parts, except with the aid of special tools. Enclosures are to have notices giving the voltage value.

15.2.6 Electrical cooking appliances being part of galley equipment are to be so designed as to prevent the possibility of cooking utensils contact with live parts, and to avoid a short-circuit or insulation damage due to the liquid leakage.

15.3 FUEL OIL AND LUBRICATING OIL HEATERS

15.3.1 Heating of fuel oil and lubricating oil having a flash point over 60 °C may be effected with electrical heaters provided the requirements of 15.3.2 and 15.3.3 are met.

15.3.2 Electrical heaters of pipelines are to be fitted with devices for temperature control, a visual alarm to indicate operating conditions, and also with a visual and audible alarm on malfunctions and impermissible temperature rise.

15.3.3 Electrical heaters of fuel oil and lubricating oil tanks are to be fitted with devices for temperature control of a heated medium, temperature sensors for the heating elements surface, low level indicators and means for disconnection of power supply to the heaters if the upper temperature limit and the lowest permissible level are exceeded.

15.3.4 Fuel oil and lubricating oil heaters are to be fitted with devices to control the temperature of a heated medium. Irrespective of the above devices, a manually disengaged device is to be provided to de-energize the heaters as soon as their surface temperature reaches 220 °C.

16 CABLES AND WIRES

16.1 GENERAL

16.1.1 The requirements of the present Section do not cover radio-frequency, telephone cables, and also power cables rated over 1000 V.

16.2 CABLE CONDUCTORS

16.2.1 Conductors of cables intended for supply of essential services are to be stranded (refer also to 16.8.1.2). Table 16.2.1 specifies the minimum number of wires per conductor.

Table 16.2.1

Nominal cross-sectional area of the conductor, in mm^2	Minimum number of wires per conductor	
	Circular non-tightened conductors	Tightened sector and circular conductors
0,5 — 6	7	—
10 — 16	7	6
25 — 35	19	6
50 — 70	19	15
95	37	15
120 — 185	37	30
240 — 300	61	30

Note. The ratio between nominal diameters of any two wires in the mechanically tightened cable conductor is not to exceed 1:1,3, and for geometrically formed but not tightened conductors, 1:1,8.

16.2.2 Connections of separate conductor wires are to be displaced relative to one another along the conductor at a distance of at least 500 mm. Such connections are not to impair mechanical and electrical properties of the wire and to change the cross-sectional area of the wire and the conductor as a whole.

16.2.3 Separate wires of rubber-insulated copper conductors are to be tinned or coated with a suitable alloy.

Tinning or other corrosion-resistant coating of external stranding or of all the wires of a rubber-insulated conductor may be dispensed with if the Manufacturer takes steps to assure that the rubber insulation does not affect adversely the metal of the conductor.

No tinning is required for conductors provided with other types of insulation.

16.3 INSULATING MATERIALS

16.3.1 Insulating materials specified in Table 16.3.1 may be used for cables and wires insulation.

Application of other insulating materials is subject in each case to special consideration by the Register.

Table 16.3.1

Insulation symbols	Standard types of insulating materials	Permissible operating temperature, in °C[1]
PVC/A	Standard-type polyvinylchloride	60
PVC/D	Heat-resistant polyvinylchloride	75
EPR	Ethylene-propylene rubber	85
XLPE	Cross-linked polyethylene	85
S95	Silicone rubber	95
[1] Wire temperature for calculation of the permissible sustained load of a cable.		

16.4 CABLE SHEATHING

16.4.1 Protective sheathing of cables and wires may be made of non-metallic materials specified in Table 16.4.1, lead and copper.

Application of sheathing made of other materials is subject in each case to special consideration by the Register.

Table 16.4.1

Sheathing symbol	Type of non-metallic solid protective sheathing	Maximum permissible cable temperature, in °C
SVI	Standard-type polyvinylchloride	60
SV2	Heat-resistant polyvinylchloride	85
SP1	Polychloroprene rubber	85
SH1	Chlorosulphonated polyethylene	85

16.4.2 Protective sheathing is to be of the same thickness within allowable limits, along the full manufacturing length of the cable and to envelope concentrically the cable cores. Sheathing is to form an impervious covering in tight contact with the cores protected.

16.4.3 Lead cable sheathing is to be made of appropriate alloys specified by national standards.

Pure lead sheathing may be used only when they are covered with an additional protective sheathing.

16.5 PROTECTIVE COVERINGS

16.5.1 Braided shield is to be made of tinned copper wire. If plain copper wire is used, it is to be protected with an appropriate sheathing. Non-shielding braids may be made of galvanized steel wire. The braid is to be uniform, and its density is to be such that the braid mass is equal to at least 90 per cent of the mass of the same diameter tube made of the same material and having the wall thickness equal to the diameter of the braiding wire.

16.5.2 Metal armour is to be made of annealed and galvanized steel wire or tape helically wound with an appropriate pitch over the cable sheathing or an intermediate bedding over the sheathing in such a way that a continuous cylindrical layer is formed to ensure protection and flexibility of the finished cable. On special demand, the armour may be made of non-magnetic metals using the above technique.

16.5.3 Cable armour or braid made of steel tape or wire is to be effectively protected against corrosion.

16.5.4 Armour bedding is to be made of moisture-resistant materials.

16.6 MARKING

16.6.1 Rubber- or polyvinylchloride-insulated cables having a limiting temperature at core over 60 °C are to be marked in a way enabling their identification.

16.6.2 Cable cores are to be marked in a way ensuring adequate preservation of their markings. Multi-core cables with cores arranged in several concentric layers are to have at least two adjacent cores in each layer marked with different colours.

16.7 HOOKUP WIRES

16.7.1 Solid insulated conductors (refer also to Table 16.3.1) having a cross-sectional area up to 50 mm^2 may be used for internal wiring in switchboards and electric devices. Solid conductors with a cross-sectional area over 50 mm^2 are allowed for wiring from protection devices (circuit breakers, fuses) to outgoing terminals.

16.7.2 Non-insulated conductors and busbars may be used for internal wiring of electric devices. Non-insulated conductors from busbars to protection devices are to be as short as practicable, but not no more than 1 m. External wiring with use of non-insulated conductors or busbars is allowed provided they are effectively guarded.

16.8 CABLING

16.8.1 General.

16.8.1.1 Non-combustible and flame-retardant cables and conductors with copper cores manufactured in accordance with the requirements of the present Part of the Rules or with the current standards approved by the Register are to be used. The use of other types of cables and conductors is subject in each case to special consideration by the Register.

16.8.1.2 Cables and wires with stranded conductors are to be used, and the cross-sectional area of the conductor is to be not less than:

.1 1,5 mm^2 for supply circuits or power and heating installations and lighting;

.2 1,0 mm^2 for supply circuits of installations not specified in 16.8.1.2.1, and for control and signalling circuits of essential services;

.3 0,75 mm^2 for control and signaling circuits;

.4 0,5 mm^2 with the number of cores in the cable not less than four for instrumentation and internal communication circuits.

Cables with a single-wire conductor having a cross-sectional area of 1,5 mm^2 and less may be used for supply of non-essential services.

Flexible cables and conductors with a cross-sectional area of not less than 0,75 mm^2 may be used for connecting portable devices for a rated current up to 6 A inside accommodation and public spaces.

16.8.1.3 In circuits with heavy inductive and capacitive loads cables designed for a working voltage approximately equal to twice the rated voltage of the circuit are to be used.

16.8.1.4 The maximum permissible temperature for the insulating material of cable cores and wires is to be at least 10 °C higher than the ambient temperature specified.

16.8.1.5 In locations exposed to petroleum products or other aggressive medium attack, cables having a sheathing resistant to such a medium are to be used. The cables lacking the above properties may be installed in such locations in metallic pipes only (refer to 16.8.8).

16.8.1.6 In locations where cables may be subjected to mechanical damages, cables provided with an appropriate armour are to be used, while the cables of other types are to be protected in such locations or laid in pipes (refer to 16.8.8).

16.8.1.7 Cables feeding the electric drives of a sprinkler system and fire pump from the emergency source of electrical power and laid through casings of Category A machinery spaces, galleys, drying rooms and other similar fire-hazardous spaces are to be of fire-resistant type or protected from flame exposure.

The above requirements also apply to the remote-control cables of those devices.

16.8.1.8 The cables of service communication, a fire detection and alarm system, an alarm warning of starting the fire-smothering system, a general alarm system, an alarm indicating closing of watertight doors, lighting, as well as the feeders of lighting fixtures and emergency consumers are not to pass through Category A machinery spaces, boiler rooms, galleys and other enclosed spaces of a high fire hazard, and also through their casings, except for cases when the devices and mechanisms of those systems are installed in such spaces.

Cables over the external bulkheads of such spaces are to be laid at the distance not less than that specified in 16.8.4.1.

On ships which dimensions do not permit to fulfil the above requirements, measures are to be taken to effectively protect the cables running through spaces of a high fire hazard.

16.8.2 Selection of cables and wires for loads required.

16.8.2.1 Continuous permissible current loads for single-core cables and wires with different insulating materials are to comply with the values specified in Table 16.8.2.1.

Table 16.8.2.1

Continuous permissible current loads, in A, of single-core cables and wires with different insulating materials for ambient temperature of 40 °C

Nominal cross-section of the conductor, in mm^2	Insulating material				
	Polyvinylchloride	Heat-resistant polyvinyl-chloride	Butyl rubber	Ethylene-propylene rubber, cross-linked polyethylene	Silicone rubber or mineral insulation
	Maximum permissible working temperature of the conductor, in °C				
	60	75	80	85	95
1,0	9	14	16	17	21
1,5	14	18	21	22	32
2,5	19	26	28	30	34
4	25	35	37	40	44
6	34	44	48	52	58
10	46	62	67	72	79
16	62	82	90	96	105
25	82	108	118	127	142
35	100	135	150	127	173
50	121	162	177	196	210
70	156	205	230	241	268
95	189	248	278	292	326
120	219	292	321	338	378
150	253	335	364	389	431
185	287	378	417	443	494
240	334	448	492	522	-
300	385	513	567	600	-

The current loads given in the Table apply to the following cable layings:

.1 when not more than six cables are laid in one bunch or one row fitted tightly to one another;

.2 when cables are laid in two rows regardless of the number of cables in the row provided the cables of a group or bunch consisting of six cables are spaced for air circulation.

Where a bunch comprises over six cables which may be under the rated current simultaneously, or where no free space for air circulation between the cables is provided, the current ratings for a given cross-section according to the Table are to be reduced by 15 per cent (factor 0,85).

16.8.2.2 The value of rated loads in amperes for cross-sections given in Table 16.8.2.1, and also for other sections are calculated by the following formula:

$$I = \alpha S^{0,625} \qquad (16.8.2.2)$$

where α = factor corresponding to the maximum permissible working temperature of the conductor according to Table 16.8.2.2;

S = nominal cross-section of the conductor.

16.8.2.3 The permissible current loads for double-, triple- and quadruple-core cables are to be determined by reducing the loads specified in Table 16.8.2.1 for a given cross-section using the following correction factors:

0,85 – for double-core cables;

0,70 – for triple- and quadruple-core cables.

16.8.2.4 The permissible current loads for cables and wires in circuits with an intermittent or short-time loading are to be determined by multiplying the continuous cable loads specified in Table 16.8.2.1 or calculated according to Formula (16.8.2.2) by the correction factors given in Table 16.8.2.4.

16.8.2.5 The permissible current loads specified in Table 16.8.2.1 are given for an ambient temperature of 40 °C.

The correction factors to be introduced depending on the ambient temperature for conversion of the permissible loads are given in Table 16.8.2.5.

16.8.2.6 When selecting cables for end circuits of lighting and cooking appliances no correction factors of a current load or simultaneity are applicable.

Table 16.8.2.2

Correction factor α

Factor for nominal cross-sectional area, in mm^2	Maximum permissible temperature of the conductor, in °C						
	60	65	7	75	80	85	90
⩾ 2,5	9,5	11	12	13,5	15	16	18
< 2,5	8	10	11,5	13	15	16	20

Table 16.8.2.4

Correction factors for cables and wires with or without metal sheathing

Nominal cross-section of the conductor, in mm^2	Intermittent service, cyclic duration 40 per cent		Short-time service, 30 min		Short-time service, 60 min	
	Cables and wires					
	with metal sheathing	without metal sheathing	with metal sheathing	without metal sheathing	with metal sheathing	without metal sheathing
1	1,24	1,09	1,06	1,06	1,06	1,06
1,5	1,26	1,09	1,06	1,06	1,06	1,06
2,5	1,27	1,10	1,06	1,06	1,06	1,06
4	1,30	1,14	1,06	1,06	1,06	1,06
6	1,33	1,17	1,06	1,06	1,06	1,06
10	1,36	1,21	1,08	1,06	1,06	1,06
16	1,40	1,26	1,09	1,06	1,06	1,06
25	1,42	1,30	1,12	1,07	1,06	1,06
35	1,44	1,33	1,14	1,07	1,07	1,06
50	1,46	1,37	1,17	1,08	1,08	1,06
70	1,47	1,40	1,21	1,09	1,09	1,06
95	1,49	1,42	1,25	1,12	1,11	1,07
120	1,50	1,44	1,28	1,14	1,12	1,07
150	1,51	1,45	1,32	1,17	1,14	1,08
185	-	-	1,36	1,20	1,16	1,09
240	-	-	1,41	1,24	1,18	1,10
300	-	-	1,46	1,28	1,20	1,12

Table 16.8.2.5

Correction factors depending on the ambient temperature

Limiting temperature of the conductor, in °C	Ambient temperature, in °C										
	35	40	45	50	55	60	65	70	75	80	85
60	1,29	1,15	1,00	0,82	—	—	—	—	—	—	—
65	1,22	1,12	1,00	0,87	0,71	—	—	—	—	—	—
70	1,18	1,10	1,00	0,89	0,77	0,63	—	—	—	—	—
75	1,15	1,08	1,00	0,91	0,82	0,71	0,58	—	—	—	—
80	1,13	1,07	1,00	0,93	0,85	0,76	0,65	0,53	—	—	—
85	1,12	1,06	1,00	0,94	0,87	0,79	0,71	0,61	0,50	—	—
90	1,10	1,05	1,00	0,94	0,88	0,82	0,74	0,67	0,58	0,47	—
95	1,10	1,05	1,00	0,95	0,89	0,84	0,77	0,71	0,63	0,55	0,45

16.8.2.7 Cables are to be designed so as to withstand the maximum short-circuit current in the circuit with due regard for a time-current characteristic of protective devices and for the peak value of the prospective short-circuit current of the first one half period.

16.8.2.8 Cables laid in parallel for the same phase or pole are to be of one type, be laid together and have the same cross-section of at least 10 mm^2 and the same length.

16.8.3 Selection of cable cross-sectional area for permissible voltage drop.

16.8.3.1 Voltage drop across the cable connecting generators with the main or emergency switchboard is not to exceed 1 per cent.

16.8.3.2 Voltage drop between the main or emergency switchboard busbars and any point of the installation under normal operating conditions is not to exceed 6 per cent of the rated voltage. This value may be increased up to 10 per cent for consumers fed from an accumulator battery rated at up to 50 V.

In order to ensure light characteristics specified it may be required to limit the voltage drop by a lesser value for navigation lights circuits.

The greater voltage drop may be allowed at short-term loads, e.g. when starting electric motors if it does not cause disturbance in the normal operation of the ship's electrical installation.

16.8.3.3 The cables feeding directly-started a.c. electric motors are to be calculated in such a manner that the voltage drop across the motor terminals at starting does not exceed 25 per cent of a rated voltage.

The possibility to raise the above voltage drop is subject in each case to special consideration by the Register.

16.8.4 Cables laying.

16.8.4.1 Cables are to be laid in straight and accessible routes if possible.

Cable runs are to pass through locations where cables are not exposed to lubricating oil, fuel oil, water and excessive external heating.

Cable runs are to be at a distance of at least 100 mm away from heat sources.

16.8.4.2 No cables are to be laid at a distance of at least 50 mm from the double bottom and fuel oil or lubricating oil tank.

Cables are to be at a distance of at least 20 mm from the shell plating, as well as from fireproof, watertight and gastight bulkheads and decks.

16.8.4.3 Metal-sheathed cables may be installed on light metal structures or anchored with light metal staples only when reliable anti-corrosion protection is used.

16.8.4.4 No through cable runs are generally allowed in the holds of dry cargo ships for the carriage of dangerous goods.

Admissibility and the ways of cable laying in such holds are subject in each case to special consideration by the Register.

16.8.4.5 It is recommended to avoid cable laying under the plating of machinery spaces. Where such laying is required, cables are to be laid in metallic pipes or closed conduits (refer to 16.8.8).

16.8.4.6 Cables installed across expansion joints are to be provided with expansion loops having a radius adequate for such a joint.

The inner diameter of the loop is to be at least 12 outside diameters of the cable.

16.8.4.7 Laying of cables with insulation having different permissible temperatures, in the common cable runs is to be effected so that cables do not heat above the permissible temperature.

16.8.4.8 Cables having different protective sheathings the less resistant of which may be damaged, are not to be installed in one common pipe, duct or in a different way of not supported common laying.

16.8.4.9 The main current cables of electric propulsion plants are to be laid at a distance of at least 0,5 m from lower voltage cables or those for other purposes.

16.8.4.10 The cores of multi-core cables are not to be used for supply and control currents of essential services not associated with one another.

Multi-core cables are not to be used simultaneously for a safety voltage and service voltages exceeding the safety level.

16.8.4.11 When services are supplied through two separate feeders, the last are to be laid in different cable runs spaced horizontally and vertically as far as possible.

16.8.4.12 When cables are laid in ducts and other structures made of combustible materials, the ways of cable laying are to be protected against ignition with fire-protective means like lining, coating or impregnation.

16.8.4.13 The cables laid are not to be sunk flush into thermal or acoustic insulation if it is made of combustible materials. The cables are to be separated from such insulation with the lining of a non-combustible material or laid at a distance of at least 20 mm from it.

If laid in thermal or acoustic insulation made of non-combustible materials, the cables are to be calculated with the relevant load reduction.

16.8.4.14 Cables laid in refrigerated spaces are to be provided with a protective sheathing made of metal, polychloroprene rubber or other material resistant to the effect of a cooling agent.

Where cables are provided with armour, the last is to be properly protected against corrosion.

16.8.4.15 Cables in refrigerated spaces are to be laid on perforated panels or bridges and anchored in such a way that a free space remains between the cables and the space walls. Panels, bridges and cable clips are to be protected against corrosion.

If cables pass through thermal insulation of a refrigerated space, they are to run through it at a right angle inside the proper sleeve sealed at both sides.

16.8.4.16 In cable laying the minimum inner radii of cable bends are to be kept in accordance with Table 16.8.4.16.

Table 16.8.4.16

Cable type		External diameter of the cable, in mm	Minimum bending radius of the cable
Cable insulation material	Type of protective sheathing of the cable		
Rubber or polyvinylchloride	Armoured with metal tape or wire	Any	10*d*
	Metal braid	Any	6*d*
	Lead alloy and armour	Any	6*d*
	Other sheathings	Up to 9,5	3*d*
		9,5 to 25,4	4*d*
		Over 25,4	6*d*
Varnished cambric	Any	Any	8*d*
Mineral insulation	Metal	Up to 7	2*d*
		7 to 12,7	3*d*
		Over 12,7	4*d*
Ethylene-propylene rubber or cross-linked polyethylene	Semiconducting and/or metal		10*d*

16.8.4.17 Cables and earthing jumper straps of equipment installed on shock absorbers are to be terminated so as to prevent their damage in service.

16.8.4.18 Cables laid on open parts of the ship and masts are to be protected against direct exposure to sun radiation.

16.8.5 Cables fastening.

16.8.5.1 Cables are to be properly fastened with staples, clips, grips, etc. made of metal or non-combustible or not readily ignitable material.

The fastener surface is to be sufficiently wide and without sharp edges. The fasteners are to be selected so as to prevent damages to protective sheathing of cables.

16.8.5.2 Distances between fastening points of horizontally-laid cables are not to exceed values specified in Table 16.8.5.2.

These distances may be increased by 25 per cent for vertically-laid cables.

Table 16.8.5.2

External diameter of the cable, in mm		Distance between fastening points for cables, in mm		
Over	Up to	No armour	With armour	With mineral insulation
—	8	200	250	300
8	13	250	300	370
13	20	300	350	450
20	30	350	400	450
30	—	400	450	450

16.8.5.3 Cables fastening is to be effected in such a way that mechanical forces in cables are not transmitted to their inlets and terminations.

16.8.5.4 Cable runs and cables laid parallel to the ship's hull plating are to be fastened to the ship's framing and not to the plating.

Cables are to be fastened to watertight bulkheads and masts on special structures (saddles, tray plates, chocks, etc.).

16.8.5.5 Cables running parallel to bulkheads subjected to sweating are to be laid on bridges or perforated panels in such a way that a free space remains between the cables and bulkheads.

16.8.5.6 Cable runs are to have the minimum number of crossings. Bridges are to be used where cables intersect. An air gap of at least 5 mm is to be provided between the bridge and cable run crossing it.

16.8.5.7 For ships constructed from non-conducting materials, an equivalent to the requirements for installation, fastening and sealing of penetrations of cables and cable runs specified in the Rules for steel ships due to the technology of hull construction from the above materials, to the materials used, etc., is allowed.

16.8.6 Cable penetrations through decks and bulkheads.

16.8.6.1 Cable penetrations through watertight, gas-tight and fire-proof bulkheads and decks are to be sealed.

Seals at places of cable penetrations through the above bulkheads and decks are not to impair their tightness, and the cables are not to be subjected to forces due to elastic hull deformations.

16.8.6.2 Where a cable is laid through non-tight bulkheads or framing components less than 6 mm thick, openings for cable passing are to be provided with linings or bushings to prevent damage to the cable.

Where the above thickness is 6 mm and over, the lining or bushing is not required, but the opening edges are to be rounded.

16.8.6.3 Cables laying through watertight decks is to be effected in one of the following ways:

.1 in metal pipes (risers) protruding above the deck to a height of at least 900 mm in locations of potential mechanical damage to the cable, and to a height not less than that of the door sill in the space with no such a risk;

.2 in common metal sleeves or boxes with additional cable protection with enclosures having the height specified in 16.8.6.3.1.

The boxes are to be packed with a stuffing compound, while the pipes are to be provided with glands or sealed with a cable compound.

16.8.7 Packing compounds.

16.8.7.1 In order to fill cable boxes in watertight bulkheads and decks, packing compounds are to be used which have good adhesion to the inner surfaces of cable boxes and cable sheathing, are resistant to water and oil product attacks and do not shrink and break tightness in continuous service under the conditions specified in 2.1.1 and 2.1.2.

16.8.7.2 Packings of cable penetrations through fire-proof bulkheads are to withstand the standard fire test specified for the given type of a bulkhead in Part V "Fire Protection".

16.8.8 Cables laying in pipes and conduits.

16.8.8.1 Metal pipes and conduits encasing cables are to be protected against corrosion on the inside and outside. The inner surface of pipes and conduits is to be even and smooth. Pipe and conduit ends are to be machined or protected so as to prevent damages to cables while the last are drawn in. Lead-covered cables not having an additional protective coating are not to be laid in pipes and conduits.

16.8.8.2 The bending radius of a pipe or conduit is not to be less than the permissible one for the largest diameter cable laid in this pipe or conduit (refer to 16.8.4.16).

16.8.8.3 The total area of all cable cross-sections determined from outside cable diameters is not to exceed 40 per cent of the inside cross-sectional area of the pipe or conduit.

16.8.8.4 Pipes and conduits are to be mechanically and electrically continuous and securely earthed if the earthing has not been already effected by the way of pipe and conduit laying.

16.8.8.5 Pipes and conduits are to be laid so as to avoid water accumulation therein.

Ventilation holes are to be provided in pipes and conduits if required. These holes, where possible, are to be in the highest and lowest points to ensure air circulation and to prevent vapour condensation.

The holes in pipes and conduits are allowed only at places where they do not enhance the hazard of explosion or fire.

16.8.8.6 Pipes and conduits for cables laid fore-and-aft which may be damaged due to deformations of the ship's hull are to be provided with compensation devices.

16.8.8.7 If the use of cables having a combustible sheathing is allowed according to 16.8.1.1, they are to be laid in metal pipes.

16.8.8.8 Cables laid in vertical pipes and conduits are to be secured so as to prevent their damage under tension due to gravity.

16.8.9 Special requirements for alternating-current single-core cables laying.

16.8.9.1 It is not recommended to use single-core cables for alternating current. However, if used in circuits rated over 20 A, such cables are to meet the following requirements:

.1 cables are not to have coatings of a magnetic material;

.2 cables relating to one circuit are to be laid in one cable run or pipe and to have the minimum length possible. Such cables may be laid in their own screen (pipe) earthed at one point and isolated from the screens of other cables and the ship's hull;

.3 cable fastenings, but those made of non-magnetic materials, are to enclose all the single-core cables of one circuit;

.4 cables are to be spaced for not more than one cable diameter.

16.8.9.2 Where single-core cables run through bulkheads or decks, no magnetic material is to be between the cables relating to one circuit. The distance between such cables and magnetic materials is to be at least 75 mm.

16.8.9.3 Where cables for a rated current over 250 A are laid parallel to steel structures, these cables and structures are to be spaced for at least 50 mm.

16.8.9.4 Where single-core cables with a cross-sectional area over 185 mm^2 are laid, the cables jumpering is to be effected in 15 m intervals. No jumpering is needed for cables under 30 m long.

16.8.9.5 Multicore cables with conductors in parallel are to be laid as single-core cables, and all the requirements for single-core cables are applicable to them.

16.8.10 Connection and tapping of cables.

16.8.10.1 Ends of rubber-insulated cables to be inserted into machines, apparatus, switchgear and other equipment are to have contact, protective and packing terminations ensuring a reliable electrical contact and preventing moisture penetration inside the cable, as well as protecting cable cores insulation from mechanical damages, and air and oil vapour effects.

Cores of rubber-insulated cables are to be provided with protection of their insulation against damage (wear, etc.) at places of connection.

16.8.10.2 The protective sheathing of a cable being inserted into a device is to fit into it for at least 10 mm.

16.8.10.3 If tapped off, the cables are to be connected in branch boxes using clamps.

16.8.10.4 Where additional connections in cable laying are required, these are to be effected in proper joint boxes provided with clamps. The joint as a whole is to be protected against ambient conditions.

The use of cable joints and other ways of cable connections, but the above mentioned, is subject in each case to special consideration by the Register.

16.8.10.5 The armouring, shielding and metal sheathing of cables are not to be used as conductor wires or earthing wires.

17 ELECTRIC PROPULSION PLANTS

17.1 The electric propulsion plant is subject to special consideration by the Register in each particular case.

18 ADDITIONAL REQUIREMENTS FOR ELECTRICAL EQUIPMENT DESIGNED FOR A VOLTAGE IN EXCESS OF 1000V

18.1 GENERAL

18.1.1 The requirements of the present Section cover electrical equipment rated over 1000 V, but not in excess of 11000 V for alternating current, and supply the requirements given in other Chapters of the present Part.

18.1.2 Insulating materials for electrical equipment are to ensure the insulation resistance of 1500 ohms per 1V rated voltage, but not less than 2 megohms during the ship's continuous service.

18.1.3 Caution notes indicating the voltage value are to be provided at the entrance into a special electrical space. The similar notes are to be provided for enclosures of electrical equipment installed outside special electrical spaces.

18.2 DISTRIBUTION OF ELECTRICAL POWER

18.2.1 Distribution systems.

18.2.1.1 The following electrical power distribution systems may be used in the ship's installations:

isolated three-phase three-wire systems;

three-phase three-wire systems with a neutral point earthed to the ship's hull through a high-value resistor or another current-limiting device, e.g. a reactor.

18.2.1.2 The impedance of the neutral earthing point is to be so selected that a short-circuit current to the ship's hull does not exceed the rated current of the largest generator in a given system, but is not less than the three-fold value of the current sufficient for activation of each type of the ship's hull-fault protection used.

It is allowed to connect all resistors (reactors) to the common earthing busbar, which is to be connected to the ship's hull at least at two points.

18.2.1.3 Where the system of electrical power distribution consists of separate sections, which are capable of independent operation, each of them is to be provided with a separate earthing resistor (reactor).

18.2.1.4 Neutral points of generators intended for operation in parallel may be interconnected before an earthing resistor (reactor).

18.2.1.5 The neutral point of a generator is to be earthed through a resistor (reactor) in the switchboard or immediately at the generator.

18.2.1.6 The neutral of each generator is to be provided with a disconnector that may cut off the neutral point earthing of the generator.

18.2.2 Permissible voltages.

Rated voltages in electrical power distribution systems are not to exceed the values given in Table 18.2.2.

Table 18.2.2

Rated interphase voltage, in kV	Rated frequency, in Hz
3 (3,3)	50 (60)
6 (6,6)	50 (60)
10 (11)	50 (60)

18.2.3 Supply from external source of electrical power.

Supply from external source of electrical power is allowed only for ships operated at mooring, such as floating docks, dredgers, drilling ships, etc.

18.3 PROTECTION DEVICES

18.3.1 General.

18.3.1.1 Where different voltages in electrical equipment are used, measures are to be taken to prevent transfer of a higher voltage to lower-voltage circuits.

18.3.1.2 Overload protection is to be provided in all the phases of alternating current systems. No fuses are allowed.

18.3.1.3 A visual and audible alarm to indicate the ship's hull fault is to be installed in the ship's mains with an insulated neutral point. This alarm is not recommended in the ship's mains with an earthed neutral point.

18.3.1.4 Temperature sensors are to be provided for stator windings of electrical machinery to alarm the rise of the windings temperature above the permissible level.

18.3.2 Protection of generators.

18.3.2.1 Generators are to be provided with an earth-fault protection.

18.3.2.2 Generators are to be de-excited at activation of any type of generators protection.

18.3.2.3 Generators are to be provided with a device to protect against internal faults and a short circuit in the cable connecting generators to a switchboard.

18.3.3 Protection of transformers.

18.3.3.1 Transformers are to be protected on a high-voltage side against a short circuit with circuit breakers.

18.3.3.2 Transformers on a low-voltage side are to be protected against an overload.

18.3.3.3 Instrument voltage transformers are to be protected against a short circuit with fuses.

18.4 PROTECTIVE EARTHING

18.4.1 Metal enclosures of electrical equipment are to be earthed with external flexible copper conductors having a cross-section designed for a single-phase short-circuit current, but not less than 16 mm^2. Earthing wires are to be marked.

18.4.2 Earthing conductors may be joined by welding or with bolts not less than 10 mm in diameter.

18.5 ARRANGEMENT AND DEGREE OF ELECTRICAL EQUIPMENT PROTECTION

18.5.1 Electrical equipment is to be installed in special electrical spaces and to have an enclosure not below IP23 (refer also to 18.6).

Terminal boxes of rotating electrical machines are to have the degree of protection not below IP44.

If justified, the equipment may be installed outside special electrical spaces provided its enclosure is not below IP44 and current-carrying parts are accessible only when de-energized or using special tools.

18.5.2 The diagram of connections and electrical equipment arrangement is to be available in the special electrical space.

18.6 SWITCHGEAR

18.6.1 Switchboards are to be locked with a special key other than those for low-voltage switchboards and switchgear.

Opening of doors or drawing separate components out is to be possible only after disconnection of the panel or switchboard from the electrical power supply.

18.6.2 Automatic circuit breakers used in switchboards are to be of the sliding type.

Circuit brakers are to be provided with a device to fix them in the withdrawn position.

When the circuit breaker is drawn out, automatic screening of opened fixed live contacts with insulating shutters is to be provided.

18.6.3 For the purpose of protective earthing, a short-circuiting device incorporated in a switchboard and designed for the maximum short-circuit current is to be provided on busbars and outgoing feeders. On agreement with the Register, the device may be portable.

18.6.4 Passageways are to be provided along a switchboards for its and electrical apparatus inspection. Their width is to be at least 800 mm between the bulkhead and switchboard, and at least 1000 mm between the parallel sections of the switchboard.

Where such passageways are intended for maintenance, their width may be increased up to 1000 mm and 1200 mm respectively.

The width of those passageways is specified regardless of the type of contact protection means used like tight doors, guard nets and insulating rails.

Doors, continuous bulkheads and net screens are to be at least 1800 mm high.

Perforated bulkheads or net screens are to ensure the degree of protection not below IP2X.

Two insulating guardrails are to be fitted along the switchboard at the height of 600 mm and 1200 mm.

18.6.5 Live parts of the electrical installation are to be spaced from protective guards at a distance not less than that specified in Table 18.6.5.

Table 18.6.5

Rated voltage, in V	Minimum height of the passageway, in mm	Minimum distance, in mm, of live parts from protective guards like:		
		tight doors and bulkheads	net doors and screens	insulating guard rails
3 (3,3)	2500	100	180	600
6 (6,6)	2500	120	200	600
10 (11)	2500	150	220	700

18.6.6 The air clearance between lives parts with different potentials or lives parts and earthed metal parts or the casing is to be not less than that specified in Table 18.6.6.

Table 18.6.6

Voltage, in kV	Minimum air clearance, in mm
3 (3,3)	55
6 (6,6)	90
10 (11)	120

18.6.7 The main switchboard is to be provided with disconnectors to split a busbar system into at least two independent sections, each supplied by at least one generator.

18.6.8 Where a power source is required to actuate circuit breakers and other switches, a power store is to be sufficient for at least two actuations of all the apparatus.

18.7 TERMINAL BOXES

18.7.1 All the terminals of stator windings in generators and motors are to be brought out to a separate terminal box other than that for lower voltages.

18.7.2 Installation of wires and connections for lower voltages are not allowed in cabinets, sockets and terminal boxes of electrical equipment.

18.8 TRANSFORMERS

18.8.1 Dry-type transformers fitted with earthed screens between the windings of the highest and lowest voltages are to be used.

18.8.2 Tripping of a transformer on the high-voltage side is to cause tripping of the switch on the low-voltage side.

18.8.3 If there is an insulated neutral point on the low-voltage side of transformers, a spark gap is to be provided between the neutral point of each transformer and the ship's hull. The spark gap is to be rated for not more than 80 per cent of the minimum test voltage of the devices fed through the given transformer.

18.8.4 The apparatus for monitoring the condition of low-voltage installation insulation and for detecting the location of this insulation damage may be connected in parallel to the spark gap. Such apparatus is not to interfere with the reliable operation of the spark gap.

18.8.5 Provision is to be made for effective measures (e.g. heating) to prevent moisture condensation and accumulation inside the transformers when deenergized.

18.9 CABLING

18.9.1 A three-phase cable network is to be made with triple cables having multiwire cores.

18.9.2 The cross-sectional area of the cable core for power circuits is to be at least 10 mm^2.

18.9.3 The design, type and permissible current loads of the cables used are subject in each case to special consideration by the Register.

18.9.4 The cables are to be laid separately from the cables for a voltage under 1000 V.

18.9.5 The following conditions are to be met in cable laying:

.1 joint laying of cables intended for transmission of electrical power of different voltages is allowed provided the insulation of all the cables jointly laid is designed for the largest of these voltages;

.2 the cables are not to run through accommodation spaces;

.3 the distance between the outer sheathing of cables for different rated voltages is to be equal to at least the double outside diameter of a thicker cable, but not less than 50 mm;

.4 the cables running outside special electrical spaces are to be laid in earthed metal pipelines or conduits, or protected with earthed metal enclosures.

Open cable laying is allowed if such cables have continuous metal armour reliably earthed.

18.9.6 Installation of joint boxes or use of other connections in order to prevent the break or elongation of a cable (splicing) is not allowed.

19 REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOLLOWING FROM THE SHIP'S PURPOSE

The present requirements amend or supply the relevant requirements of Sections 1 to 18.

19.1 PASSENGER SHIPS

19.1.1 Supply and alarm.

19.1.1.1 Electric drives of sea-water pumps, air compressors and control valves of automatic sprinkler systems are to be fed immediately from the main and emergency switchboards through separate feeders. Such feeders at to be terminated at the automatic switch fitted near the pump of the sprinkler system. This switch in normal position is to be connected to the feeder from the main switchboard and to switch over automatically to the feeder from the emergency switchboard if supply fails. The switches of these feeders on the main and emergency switchboards are to be clearly marked and to remain permanently switched-on. No other switches are to be fitted on these feeders.

19.1.1.2 Supply cables of sea-water pumps, air compressors and control valves of the automatic sprinkler system are not to be laid in cable runs passing through machinery space trunks, galleys and other enclosed spaces of high fire hazard except the cases when the above devices and machinery are installed in these spaces.

19.1.1.3 Lighting fixtures of saloons, in way of stairs, passages and ladders leading to the boat deck are to be supplied through at least two independent feeders (refer also to 6.2.3).

19.1.1.4 The supply systems of essential services are to be designed so that a fire in one of the main vertical fire zone does not damage the above supply systems of services located in any other main vertical fire zone. This requirement is considered as met if the main and emergency supply feeders of these services running through any such zone are vertically and horizontally spaced as far as practicable.

19.1.1.5 A general alarm system is to consist of two independent groups: for passengers and for the crew.

Passenger ships with the electrical installation of low power or carrying under 36 passengers may have on group of general alarm.

19.1.1.6 The electrical power for emergency lighting is to be supplied within 7 s after the failure of the main electricity supply.

19.1.2 Main source of electrical power.

The main source of electrical power is to be provided in accordance with 3.1.2.1, 3.1.3 and 3.1.4.

19.1.3 Emergency source of electrical power (refer to Section 9).

19.1.3.1 Where a diesel-generator is an emergency source of electrical power, it is to supply the following services during three hours:

.1 emergency lighting of:

overboard spaces for life-saving appliances launching according to Section 8 "Life-Saving Appliances" of Part III "Equipment, Arrangements and Outfit";

indicators of exits to the boat deck, and also of notice-plates near life-saving appliances;

exits from spaces where the large number of passengers, special personnel and crew members may be at a time, muster and embarkation stations, as well as of the overboard space where life-saving appliances are launched;

passageways, stairways of accommodation and service spaces, and exits to the open deck, as well as of passenger lift cars;

machinery and generating set spaces with their local control stations;

all control stations, as well as of the main and emergency switchboards;

emergency diesel-generator spaces;

wheelhouse;

chartroom and radioroom;

stowage places for emergency and fire outfit, fireman's outfit and places of manual fire alarms installation;

steering gear compartments;

places of attendance to an emergency fire and bilge pump, a sprinkler system pump, as well as of places where starting devices of this machinery are fitted;

gyrocompass spaces;

medical spaces;

.2 navigation lights, the lanterns of "Ship not under command" signal and other lanterns as required by European Inland Navigation Rules and Main Regulations for the Danube Navigation;

.3 radio and navigational equipment according to the requirements of Part IX "Radio Equipment" and Part XII "Navigational Equipment";

.4 internal communication, announcing and general alarm systems;

.5 fire detection and alarm systems, fire door control devices and signaling on position of fire doors specified in Part V "Fire Protection";

.6 daylight signaling lamps, sound signal means (whistles, gongs, etc), manual summoning signals and other kinds of signaling as required in case of emergency;

.7 one of fire pumps, the electric-driven pump of a pressure water-spraying system, the pump of an automatic sprinkler system, as well as the electrical equipment associated with the operation of foam generators referred to in Part V "Fire Protection";

.8 emergency bilge pump and equipment for remote control of bilge system valves;

.9 searchlight;

.10 electrical drives of watertight doors with their indicators and warning signals;

.11 emergency drive of a passenger lift. Passenger lifts may be used alternately;

.12 other systems which functioning will be recognized by the Register as essential for ensuring safety of the ship and people onboard.

The services specified in 19.1.3.1.2 to 19.1.3.1.6 may be supplied from their own accumulator batteries located according to 9.2 and having a capacity sufficient for their supply during 30 min.

19.1.3.2 An emergency diesel-generator is to be:

.1 driven by an internal combustion engine (refer to 2.2.4, Part VIII "Machinery");

.2 automatically started at the voltage loss in the main network, and also

automatically switched over to the busbars of the emergency switchboard; the total time for starting and taking a load by the generator is not to exceed 30 s;

.3 if automatic starting of the emergency set is not ensured within 30 s, provision is to be made for the emergency temporary source of electrical power which is to be switched on immediately at de-energizing and to feed services specified in 19.1.3.4.

19.1.3.3 Where an accumulator battery is the emergency source of electrical power, it is to meet the following conditions:

.1 to operate without recharging with voltage variations across its terminals within 12 per cent of the rated voltage during the whole discharge period;

.2 to be automatically connected to the emergency switchboard busbars at the voltage loss in the main network and to supply, at least, the services specified in 19.1.3.4.

19.1.3.4 The capacity of the accumulator battery being the emergency source of electrical power is to be sufficient to ensure the supply of the following services within 30 min:

.1 emergency lighting and navigation lights according to 19.1.3.1.1 and 19.1.3.1.2;

.2 internal communication and announcing systems required in emergency;

.3 general alarm systems, a fire detection and alarm system and control devices and indicators of fire doors position as specified in Part V "Fire Protection";

.4 daylight signaling lamps, sound signal means (whistles, gongs, etc.) and other kinds of signaling as required in emergency conditions;

.5 arrangements for closing watertight doors, their position indicators and signals warning of their closing; alternate closing of all doors is allowed provided that all doors will be closed within 60 s;

.6 radio equipment ensuring transmission of distress signals;

.7 searchlight.

The services listed in 19.1.3.4.2 to 19.1.3.4.6 may be fed from their own accumulator batteries located according to 9.2 and having the capacity sufficient for supply of these services within 30 min.

19.1.3.5 Emergency sources of electrical power are to ensure the supply of a steering arrangement according to 5.5.2.

19.2 OIL TANKERS AND OIL RECOVERY SHIPS

19.2.1 General.

The requirements of the present Chapter cover the electrical equipment of oil tankers for the carriage of liquids having a flash point 55 °C and below, and liquids having a flash point 55 °C and over to be heated up to a temperature not more than 15 °C below the flash point, and also the electrical equipment of ships for recovery and transportation of oil spilled on the sea surface.

19.2.2 Distribution of electrical power.

19.2.2.1 The following systems may be used for electrical power distribution:

.1 two-wire isolated system for direct current;

.2 two-wire isolated system for single-phase alternating current;

.3 three-wire isolated system for three-phase alternating current (also for voltage over 1000 V, but not exceeding 11000 V a.c.).

19.2.2.2 It is allowed to use limited and locally-earthed systems of electrical power distribution for supply of the following services provided they are used outside hazardous spaces and areas:

.1 an impressed-current cathodic protection system for external corrosion protection of the hull;

.2 insulation resistance control and measurement systems;

.3 an electric start-up system or glow plugs of internal combustion engines.

19.2.3 Dangerous zones, spaces and areas.

19.2.3.1 Classification of dangerous zones.

.1 Zone 0: in which an explosive gas/air mixture is continuously present or present for long periods;

.2 Zone 1: in which an explosive gas/air mixture is likely to occur in normal operation;

.3 Zone 2: in which an explosive gas/air mixture is not likely to occur, but if it occurs, it will only exist for a short time.

19.2.3.2 Division of dangerous spaces and areas into zones.

19.2.3.2.1 Zone 0:

.1 internal areas of cargo compartments and tanks, cargo pipelines and recovered oil transfer systems;

.2 open areas up to 1 m above the water surface covered by oil (for ships operating in the oil spill).

19.2.3.2.2 Zone 1:

.1 cofferdams and other spaces adjacent to cargo compartments and tanks;

.2 enclosed or semi-enclosed spaces containing cargo pumps or cargo pipelines provided the latter is not all-welded;

.3 enclosed and semi-enclosed spaces above the deck of cargo compartments and tanks, which have their bulkheads above or level with the bulkheads of cargo compartments and tanks;

.4 enclosed and semi-enclosed spaces located immediately above pump rooms, and also above vertical cofferdams adjacent to cargo compartments and tanks unless separated by a gastight deck and provided with a forced ventilation;

.5 areas and spaces, other than cofferdams, adjacent to cargo compartments and tanks and located below the top of cargo compartments and tanks;

.6 areas and semi-enclosed spaces on the open deck within 3 m from any ventilation outlets, cargo tank manholes and hatches, pump rooms and cofferdams adjacent to cargo tanks, cargo valves, cargo pipeline flanges. Areas in way of breathing valve and vent pipe outlets of a venting system in accordance with 9.2.4, Part VII "Systems and Piping";

.7 areas on the open deck above cargo compartments and tanks over the ship's full breadth and 3 m fore and aft of their boundary bulkheads up to a height of 2,4 m above the deck, and also enclosed and semi-enclosed spaces within this area. This area is extended for the ship's full length for ships operating in the oil spill;

.8 storage spaces for cargo hoses and equipment for collecting spilled oil (oil collectors);

.9 enclosed and semi-enclosed spaces having a direct exit or other openings into one of the above areas or spaces;

.10 spaces and areas above cofferdams, adjacent to cargo compartments or tanks, not separated by oil- and gastight bulkheads and decks, not provided with proper ventilation and entered from the deck above;

.11 spaces, in which electric motors of cargo and stripping pumps are installed, located above pump rooms.

19.2.3.2.3 Zone 2:

.1 areas above Zone 1 over the full breadth and length of the ship up to a height of 6 m above the deepest load waterline (for ships operating in the oil spill).

19.2.3.2.4 Areas and spaces not included in Zones 0, 1 and 2 are considered to be safe.

19.2.3.3 The spaces located below the upper deck and having a direct access to other openings into spaces on the upper deck listed in 19.2.3.2.7 are not regarded as dangerous if provision is made for two self-closing gastight doors forming an air lock, and also for additional forced supply ventilation with an air intake from locations outside dangerous spaces.

19.2.3.4 For ships operating in the oil spill entrances, ventilation openings (inlets and outlets) and other openings in non-dangerous spaces like accommodation, service and machinery spaces, control stations and a wheelhouse which have no gastight closures are to be located at least 6 m above the deepest waterline and, in any case, outside dangerous zones.

Entrances to safe spaces located under 6 m above the deepest waterline or within dangerous zones are to be provided with air locks. The openings in these spaces located under 6 m above the waterline are to have gastight closures while operating in the oil spill.

19.2.4 Electrical equipment in dangerous spaces and areas.

19.2.4.1 Installation of electrical equipment in dangerous spaces and areas is not allowed except the following safe-type devices:

.1 lighting fixtures and navigation lights with a pressurized enclosure (*Exp*), a flame-proof enclosure (*Exd*) or of increased safety type (*Exe*);

.2 joint boxes of the increased safety type (*Exe*) or with a flame-proof enclosure (*Exd*);

.3 intrinsically safe equipment (*Exi*) for monitoring, regulating, remote control and communication;

.4 electric motors of the increased safety type (*Exe*), with a flame-proof enclosure (*Exd*) or with a pressurized enclosure (*Exp*).

19.2.4.2 No electrical equipment and cables except those of intrinsically safe type (*Exi*) are allowed in internal spaces of cargo compartments and tanks, cargo pipelines and recovered oil transfer systems.

19.2.4.3 No electrical equipment and cables except those of intrinsically safe type (*Exi*) are allowed in open areas extending up to 1 m above the oil-covered water surface (for ships operating in the oil spill).

19.2.4.4 In cofferdams and other spaces adjacent to cargo compartments and tanks no electrical equipment is allowed except:

.1 intrinsically safe devices (*Exi*);

.2 echo-sounder transducers and their cables according to the requirements of 3.4, Part XII "Navigational Equipment";

.3 cables of impressed-current cathodic protection systems for external hull protection laid in corrosion-resistant steel pipes with gastight joints up to the upper deck.

19.2.4.5 In enclosed and semi-enclosed spaces containing cargo pumps or cargo pipelines, it is allowed to install only:

.1 electrical equipment specified in 19.2.4.4;

.2 lighting fixtures fed through at least two circuits with fuses and switches in all poles and phases located outside dangerous spaces and areas; in so doing it is allowed: lighting with the fixtures arranged outside dangerous spaces and areas through glazed dead holes in gastight bulkheads or decks provided they do not impair the strength and gastightness of these bulkheads and decks, and with explosion-proof lighting fixtures with a pressurized enclosure (*Ex*p) or with a flame-proof enclosure (*Exd*) which cables are to be protected against mechanical damages with a metal casing;

.3 cable runs for the above consumers.

Electric motors driving the equipment located in pump rooms are to be installed in adjacent safe spaces (refer to 4.2.5, Part VI "Machinery Installations"). The electric motors are to be fitted with remotely-disconnecting devices placed outside the spaces in which the motors are installed and above the cargo tank deck (refer also to 8.1.4, Part VII "Systems and Piping").

19.2.4.6 In enclosed and semi-enclosed areas above the deck of cargo compartments, tanks and spaces having bulkheads above or at the level of cargo compartment and tank bulkheads, in enclosed and semi-enclosed spaces located immediately over pump rooms, and also above vertical cofferdams adjacent to cargo compartments and tanks if they are not separated with a gastight deck and do not have forced ventilation, in spaces for storage cargo hoses and equipment for spilled oil collection, it is allowed to install only:

.1 intrinsically safe equipment (*Exi*);

.2 safe-type lighting fixtures with a pressurized enclosure (*Exp*), a flame-proof enclosure (*Exd*) or of the increased safety type (*Exe*); the switches of these lighting fixtures are to be outside dangerous spaces and areas;

.3 cable runs for the above consumers.

19.2.4.7 In spaces and areas, other than cofferdams, adjacent to cargo compartments and tanks and located below their top, it is allowed to install:

.1 electrical equipment listed in 19.2.4.4;

.2 safe-type lighting fixtures with a pressurized enclosure (*Exp*) or a flame-proof enclosure (*Exd*); in this case lighting is to be effected by means of lighting fixtures being fed through at least two circuits with fuses and switches in all poles and phases, and located outside dangerous spaces and areas;

.3 cable runs for the above consumers.

19.2.4.8 In areas and semi-enclosed spaces on the open deck within 3 m from any opening other than the ventilation one of cargo compartments and tanks, pump rooms and cofferdams adjacent to cargo tanks, from cargo valves and cargo pipeline flanges, it is allowed to install only:

.1 electrical equipment listed in 19.2.4.1;

.2 cable runs in conduits or pipes except expansion loops.

19.2.4.9 In areas on the open deck above cargo compartments and tanks (including ballast tanks used as cargo tanks) across the ship's whole breadth and by 3 m fore and aft from their end bulkheads up to a height of 2,4 m above the deck (along the whole length for ships operating in the oil spill), as well as in enclosed and semi-enclosed spaces having a direct access to or other openings into one of the above spaces or areas, it is allowed to install only:

.1 electrical equipment listed in 19.2.4.1;

.2 cable runs in conduits or pipes.

19.2.4.10 In spaces and areas over the cofferdams adjacent to cargo compartments and tanks not separated by oil- and gastight bulkheads and decks, which do not have proper ventilation and are entered from the above deck, it is allowed to install only:

.1 explosion-proof lighting fixtures with a pressurized enclosure (*Exp*), flame-proof enclosure (*Exd*) or of the increased safety type (*Exe*);

.2 other safe-type electrical equipment.

19.2.4.11 Provision is to be made for the possibility of explosive gas/air mixture formation during cargo transfer, ballasting or removing gases with mechanical means from the spaces and areas specified in 19.2.3.2.1, 19.2.3.2.2.1 to 19.2.3.2.2.10.

The electrical equipment that may function during the above operations, i.e. lighting fixtures, winches, electrical equipment installed in wheelhouse wings, etc., is to be designed so as to prevent arcs or sparks, heating of its surface up to dangerous temperatures during normal operation.

19.2.5 Portable electrical equipment used for collecting spilled oil.

19.2.5.1 Portable equipment for collecting and transfer of oil is to be of the safe type.

19.2.5.2 The switchboards or socket outlets for supplying portable oil-collecting and transfer equipment on deck are to be permanently fitted in such a way that a cable to be connected does not pass through door coamings or other openings being closed which bound dangerous spaces and areas. The design of such distribution devices or socket outlets is to provide for an interlock to prevent connection of the portable electrical equipment alive, as well as for protection against short-circuit currents and overloads in each phase.

19.2.5.3 Flexible cables used for portable electrical equipment applied during collecting of spilled oil are to have an outer sheathing made of an oil-resistant material. The cable structure is also to include a metallic braid (screen) protected by proof sheathing.

19.2.6 Cable laying.

19.2.6.1 Cable laying on decks of oil tankers and oil recovery ships is to be effected along flying bridges in proper conduits (trays) or pipes. Where flying bridges are inside the spaces specified in 19.2.3.2.2.7, the cables used are to meet the requirements of 2.9.12.

The cases not covered by this item are subject to special consideration by the Register.

19.2.6.2 The following requirements are to be met when cables are laid in conduits (on trays):

.1 cables in conduits (on trays) are to be loosely laid in rows on shaped separators of non-metallic materials; the potential lateral displacement of the row (cable) therewith is to be prevented. The ways of fixed pipeless installation of cables (in cable hangers, under clips) may also be used if their designs are approved by the Register; in this case, the fixed cables are to be laid not more than in two rows;

.2 cables are not to contact metal parts of the conduit (tray);

.3 cables are not to be subjected to constant and variable tensions due to the ship's hull deformation and protected from this deformation, especially in way of detachable or sliding connections between the gangway or platform and super-structures where expansion loops are to be provided. The inside radius of such a loop is to be at least 10 diameters of the thickest cable;

.4 cables are to be protected from direct exposure to solar radiation, sea waves, and oil products carried and mechanical damage;

.5 distances from cables to heat sources are to meet the requirements of 16.8.4.1;

.6 cable runs on a passageway platform or in pipes within the area specified in 19.2.3.2.2.7, as well as expansion loops are not to be located below 300 mm from the tank deck;

.7 metal sheathing or armour of cables are to be earthed at both ends.

For final subcircuits, earthing of a metal sheathing may be effected at one end at the start of a line.

19.3 SHIPS FOR THE CARRIAGE OF MOTOR VEHICLES WITH FUEL IN THEIR TANKS, TANK CARS AND TANK WAGONS FOR FLAMMABLE LIQUIDS

19.3.1 General.

19.3.1.1 The requirements of the present Chapter apply to electrical equipment of holds and other spaces and areas intended for the carriage of motor vehicles with fuel in their tanks, and also of tank cars and tank wagons for flammable liquids.

19.3.1.2 The holds and spaces listed in 19.3.1.1 are considered dangerous spaces and areas.

19.3.1.3 Cables are to be protected against mechanical damage. The cables installed horizontally are to be laid at a distance of at least 450 mm above a continuous deck or platform preventing free penetration of gases downwards.

Cable penetrations of decks and bulkheads are to be gastight.

19.3.1.4 Electrical equipment installed in exhaust ventilation ducts is to be of the safe type: increased safety (*Exe*) or with a flame-proof enclosure (*Exd*).

19.3.1.5 The lighting system in holds and spaces listed in 19.3.1.1 is to be divided into at least two groups, each supplied separately from an independent circuit.

19.3.2 Installation of electrical equipment in holds and spaces intended for the carriage of motor vehicles with fuel in their tanks on passenger ships and ferries.

19.3.2.1 In holds and spaces at a height over 450 mm above the cargo deck or platform preventing free penetration of gases downwards, it is allowed to install the electrical equipment having a degree of protection of at least IP55 provided the ventilation system ensures at least 10 air changes per hour.

19.3.2.2 In holds and spaces above the bulkhead deck in a zone under 450 mm above the deck or platform preventing free penetration of gases downwards, the electrical equipment to be installed is to be of the safe type: intrinsically safe (*Exi*), with a pressurized enclosure (*Exp*), with a flame-proof enclosure (*Exd*) or increased safety (*Exe*).

19.3.2.3 In holds and spaces below the bulkhead deck the electrical equipment to be installed is to be of the safe type: intrinsically safe (*Exi*), with a pressurized enclosure (*Exp*), with a flame-proof enclosure (*Exd*) or increased safety (*Exe*).

19.3.3 Installation of electrical equipment in holds and spaces for the carriage of motor vehicles with fuel in their tanks on cargo ships.

19.3.3.1 In holds and spaces at a height over 450 mm above the continuous deck or platform preventing free penetration of gases downwards, it is allowed to install the electrical equipment having a degree of protection of at least IP55 provided the ventilation system ensures at least 10 air changes per hour.

19.3.3.2 In holds and spaces in a zone below 450 mm above the cargo deck or platform preventing free penetration of gases downwards, the electrical equipment to be installed is to be of the safe type: intrinsically safe (*Exi*), with a pressurized enclosure (*Exp*), with a flame-proof enclosure (*Exd*) or increased safety (*Exe*).

19.4 CONTAINER SHIPS

19.4.1 General.

The requirements of the present Chapter cover the electrical equipment of ships designed and intended for the carriage of thermal containers.

19.4.2 Supply and distribution of electrical power.

19.4.2.1 The prescribed power of electrical devices of thermal containers is to be assumed as their rated power. The consumed power of the electrical equipment of the thermal container under rated operating conditions is not to exceed 15 kW (18,75 kVA). The use of correction factors is subject in each case to special consideration by the Register.

19.4.2.2 The devices for protection of electrical power sources against an overload specified in 8.2.3 are to ensure tripping of thermal containers from the main switchboard in the last turn (refer also to 20.2.1).

19.4.2.3 The electrical circuit supplying thermal container devices is to be separated from the ship's mains by isolating transformers fed from the main switchboard.

19.4.2.4 The electrical equipment of thermal containers is to be fed through special distribution gear supplied by separate feeders.

19.4.2.5 Socket outlets located in cargo holds or on open decks near thermal container stowage are to be supplied by separate outgoing feeders from the special distribution gear (switchboards) specified in 19.4.2.4 and 19.4.3.3.

19.4.2.6 The electrical circuit of socket outlets intended for supply of electrical equipment of thermal containers is to be rated for a 3-phase alternating current voltage of 220/380 V at a frequency of 50 Hz or 240/ 440 V at a frequency of 60 Hz.

19.4.3 Switchgear and transformers.

19.4.3.1 The switchgear (switchboards) of thermal containers, electrical converters and isolating transformers (if any) are to be installed in special electrical spaces.

19.4.3.2 The secondary winding of isolating transformers is to have an isolated zero point.

19.4.3.3 Each switchgear (switchboard) is to fitted with the apparatus ensuring:

.1 visual signaling to indicate the presence of voltage in switchboards;

.2 switching-in and tripping of each outgoing feeder supplying socket outlets;

.3 short-circuit protection at the outgoing feeders supplying socket outlets;

.4 measurement of insulation resistance.

19.4.4 Socket outlets.

19.4.4.1 In holds intended for the carriage of thermal containers it is allowed to install socket outlets used only for feeding containers having a degree of protection of at least IP55, and on open decks, IP56. Where the systems of electrical remote control over the temperature, humidity, ventilation and other parameters of thermal containers are used, it is allowed to install additional socket outlets for connection of circuits of such control devices in the holds or on decks.

19.4.4.2 In addition to the requirements of 6.5, the socket outlets for supply of the electrical equipment of thermal containers are to be fitted with a switch having an interlock preventing removal or insertion of the plug while the switch is in the on-position, and with a nameplate indicating the voltage.

19.4.4.3 The electrical equipment of thermal containers is to be supplied from the ship's mains with the direct alternation of phases A(R), B(S), C(T) according to the diagram given in Fig. 19.4.4.3.

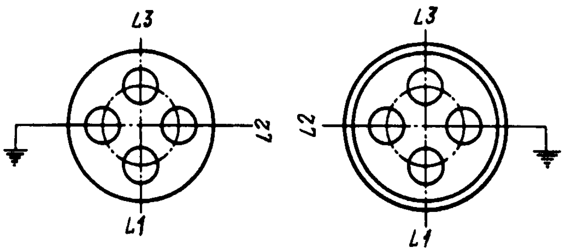


Fig. 19.4.4.3

19.4.4.4 Socket outlets intended for supply of the electrical equipment of thermal containers are to be rated at the following currents:

63 A — for a voltage of 220 V at a frequency of 50 Hz or 240 V, 60 Hz;

32 A — for a voltage of 380 V at a frequency of 50 Hz or 440 V, 60 Hz.

19.4.4.5 Plug connections are to be designed so as to prevent mating plugs rated for one voltage and a socket for another one.

19.4.4.6 The design and mounting dimensions of plugs and sockets are to comply with international standards.

19.4.5 Protective earthing.

The socket outlet jack intended for connection of the earthing conductor in the flexible cable of a thermal container is to be earthed through the earthing conductor in the supply feeder at the place where the switchgear (switchboard) to supply thermal containers socket outlets is installed.

19.5 BERTH-CONNECTED SHIPS

19.5.1 Generators and the shore-based electrical power system may be used as the main sources of electrical power for berth-connected ships.

19.5.2 Provision is to be made for at least two generators on independent berth-connected ships as the main sources of electrical power.

The ship's mains may additionally be supplied from the shore-based electrical power system.

The shore-based electrical power system only may be used for supplying non-independent berth-connected ships.

19.5.3 The output of the generators of the main source of electrical power on independent berth-connected ships or the power supplied from a shore-based electrical power system is to be sufficient to ensure the operating conditions in accordance with the ship's purpose, and also in case of fire, hull damage or other circumstances adversely affecting the safety of the berth-connected ship while the main source of electrical power is in operation.

19.5.4 The output of main generators of the independent berth-connected ship is to be sufficient to ensure the operating conditions specified in 19.5.3 if any of the generators fails.

19.5.5 Supply and alarms of essential systems and arrangements on floating hotels and hostels are to be effected in accordance with 19.1.1.1 to 19.1.1.4.

The side, bow and stern lanterns may be supplied from lighting switchboards.

19.5.6 Each floating hotel and hostel is to be provided with an independent emergency source of electrical power meeting the requirements of 19.1.3.

On other berth-connected ships the presence of the emergency source of electrical power is subject in each case to special consideration by the Register.

19.5.7 As regards the automatic starting of the emergency source of electrical power and the presence of the emergency temporary source on floating hotels and hostels, the requirements of 19.1.3.2.2 and 19.1.3.2.3 are to be met.

20 REQUIREMENTS FOR ELECTRICAL EQUIPMENT OF REFRIGERATING PLANTS

20.1 GENERAL

20.1.1 The requirements of the present Section apply to electrical equipment of classed refrigerating plants.

20.1.2 The requirements of 20.2.3, 20.2.4, 20.3.1 and 20.4 also apply to unclassed refrigerating plants.

20.2 POWER SUPPLY AND SWITCHING

20.2.1 Electric drives of refrigerating plants are to be supplied through separate feeders from the switchboard of the refrigerating plant.

The electric drives of refrigerating compressors may be supplied directly from the main switchboard.

Refrigerating fans may be supplied from the refrigerating plant switchboard or from the other switchboard fed directly form the main switchboard.

In any way of power supply the refrigerating plant drives are the last to be tripped off at generators overload.

The emergency ventilation system is to be supplied through a separate feeder from the switchboard energized from the main switchboard, or directly from the main switchboard.

20.2.2 Power supply of electric drives of thermal containers is to meet the requirements of 19.4.2.

20.2.3 Where Group II refrigerants are used (according to Table 2.2.1, Part XII "Refrigerating Plants" of Rules for the Classification and Construction of Sea-Going Ships), provision is to be made for a device ensuring emergency remote disconnection of the refrigerating plant switchboard from the following locations:

.1 the permanent control station of the refrigerating plant in the refrigerating machinery room;

.2 the location outside the space may be potentially contaminated with the Group II refrigerant in case of an accident in the refrigerating machinery room;

.3 outside and near each exit from refrigerating machinery rooms.

The device for emergency remote disconnection is to be installed so as to prevent its inadvertent activation.

20.2.4 The device for emergency remote disconnection of the switchboard of the refrigerating plant operating with the Group II refrigerant is simultaneously to trip off the electric drives of refrigerating compressors, if they are fed from the main switchboard (refer to 20.2.1), main lighting of the refrigerating machinery room and to trip on the emergency ventilation, water screens and emergency lighting.

Near the device for emergency remote disconnection of the refrigerating plant switchboard in the locations specified in 20.2.3.1 and 20.2.3.2, devices are additionally to be installed for remote starting in any sequence of emergency ventilation, water screens and emergency lighting without disconnecting the refrigerating plant switchboard.

20.2.5 Safety voltage is recommended for electrical devices heating hatches and doors from refrigerated spaces and freezing chambers.

20.3 VENTILATION

20.3.1 Where the Group II refrigerant is used, the electric motors of exhaust fans of emergency ventilation in refrigerating machinery rooms, installed in exhaust ducts, are to be of the safe type.

20.3.2 The electric motors of fans being in the air stream from refrigerated cargo spaces are to have the enclosure type at least IP55.

20.4 LIGHTING

20.4.1 Where the Group II refrigerant is used as a coolant, safe-type reserve lighting fixtures are to be installed in refrigerating machinery rooms in addition to the main lighting fixtures. The reserve lighting fixtures are to be fed separately from the electrical equipment and the main lighting fixtures installed in refrigerating machinery rooms.

21 SPARE PARTS

21.1 Every ship is to be provided with spare parts the list and quantity of which are established by the Shipowner and are subject to special consideration by the Register in each particular case.

PART X. AUTOMATION

1 GENERAL

1.1 APPLICATION AND GENERAL REQUIREMENTS

1.1.1 The requirements of the present Part apply to automated machi-nery installations of inland navigation ships for which the mark **AUT** is added to the class notation of the ship.

1.1.2 The requirements of the present Part are to be met where provision is made for operation of the ship's or floating structure machinery installation without permanent attendance of personnel in machinery spaces.

1.1.3 For passenger ships or ships with electric propulsion plants, the level of automation to grant the automation mark in the class notation is subject to special consideration by the Register.

1.1.4 Machinery, electrical and electronic equipment, as well as structural components of automation systems and the machinery itself are to comply with the requirements of the relevant parts of the Rules.

1.1.5 The requirements of the present Part apply to automation equipment (refer to 1.3.2) irrespective of whether the ship is assigned an automation mark in the class notation or not.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 For the purpose of the present Part the following definitions have been adopted.

Automated machinery plant is an installation fitted with automated control of main and auxiliary machinery and their systems, remote monitoring, alarm and safety facilities.

Remote control is changing of rotation speed and direction as well as starting and stopping of the machinery from a remote position.

Local control station is a control station fitted with controls, indicators, means of communication, located in proximity to, or directly on, the machinery (engine).

Alarm system is equipment for signalling whenever the controlled parameters reach the preset limit values or deviations of machinery and associated systems from normal working ranges occur.

Remote automated control system is equipment intended for control of machinery from a remote control station enabling an automatic execution of intermediate operations for collection and processing of information on the object and making commands to the executive devices realizing the mode of the machinery functioning set up by the operator.

Safety system is equipment to automatically affect, in a specific way, the operation of machinery under control in order to prevent an accident or limit its consequences.

Indication system is equipment providing visual information on the values of certain physical parameters and changes of certain conditions in machinery.

Automation device is a part of automation system comprising elements which form a structural and functional unity.

Main machinery control room is a special room or space containing the remote controls of main and auxiliary machinery, propellers, indicating instruments, alarm devices and means of communication.

Automation component is a structurally independent item (e.g. amplifier, sensor, relay, logic element) used in automation systems and devices.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions concerning classification procedure, technical supervision of ships during design and constructing, manufacture of equipment and items, surveys and requirements for technical documentation to be submitted to the Register for review and approval of the ship as a whole are given in General Regulations for the Classification and Other Activity and Part II "Technical Documentation" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.3.2 Subject to supervision during manufacture and in service are automation elements, devices and systems of the following:

.1 main machinery and propellers;
.2 electric power plants;
.3 auxiliary machinery;
.4 auxiliary boilers;
.5 alarm systems;
.6 other systems as required by the Register.

1.4 TECHNICAL DOCUMENTATION

1.4.1 For the automation equipment listed in 1.3.2, the following technical documentation is to be submitted to the Register:

.1 operating principle description including technical parameters, scope of functions to be performed, operating conditions and other data;

.2 general arrangement and layout;

.3 schematic diagram and functional diagram;

.4 specification including materials used, related items with indication of all elements used with their technical characteristics;

.5 list of controlled parameters of alarm and safety systems;

.6 test program.

1.4.2 The technical documentation of automation incorporated into the engineering design of the ship is to be submitted to the Register prior to the ship construction as stipulated by 4.1.10, Part I "Classification".

2 DESIGN OF AUTOMATION EQUIPMENT

2.1 GENERAL

2.1.1 The automation systems and their elements are to comply with the requirements of 2.1.1, 2.1.2, 2.1.3, 2.2.1 of Part IX "Electrical Equipment".

2.1.2 The main machinery and its essential auxiliaries are to be equipped for unattended operation in the machinery space. Remote control, alarm and safety systems are to be such as to ensure smooth functioning of the plant and safety under all operational conditions.

2.1.3 Care is to be taken to ensure that, in the event of a failure of the automation systems or breakdown of the electrical, pneumatic or hydraulic supply system for it, the controlled components remain in the condition in which they were before the failure. The failure is to be signalled.

2.1.4 Automated or remote-controlled machinery is also to be equipped with local manual controls. The manual controls are to be such that they cannot be put out of action by any breakdown of the automated or remote-controlled system.

2.1.5 Remote automated control systems are to be supplied both from the main and the emergency sources of electrical power. The emergency source of electrical power is to come into operation automatically upon failure of the main supply source.

If the emergency source of electrical power is not permanently available while the ship is under way, an accumulator battery is required.

2.1.6 Automation devices are to be so constructed that their function can be checked during the operation of the plant.

2.1.7 On the remote control station, it is to be indicated that the given commands have been executed.

2.2 AUTOMATED MAIN MACHINERY AND PROPELLERS

2.2.1 Automated main machinery is to be provided with:

.1 devices for remote control from the wheelhouse;

.2 visual indication to indicate that the systems are ready for operation;

.3 alarm system to indicate malfunction of the control system and to give alarm at the controlled parameters reaching predetermined limit values;

.4 automatic safety devices to be activated when the controlled parameters fall outside the limits of the permissible values involving an emergency condition as well as a signalling system of actuation of safety devices.

2.2.2 Hydraulic and pneumatic automation systems are to be supplied from two sources. The second source is to be connected automatically at pressure loss with application of alarm signal.

2.2.3 The electric (electronic) control systems are to be supplied from both the main and emergency sources of power. Power supply circuits of control systems are to be independent of those of the safety and alarm systems.

2.2.4 The safety system is to be so designed that in case of faults it disconnects automatically the faulty power plant or transfers the plant to the safe condition. In case of installations with two or more engines driving a single shaft, the safety system is to provide automatic disconnection of the faulty engine in such a manner, that the remaining engines maintain propulsion and manoeuvring of the ship.

2.2.5 Where ships have only one main engine, visual and audible alarm on the forthcoming inevitable actuation of safety devices designed to halt or slow down the affected equipment is to be provided. On the navigating bridge, in close proximity to the steering position, means are to be provided for disconnecting the above-mentioned safety devices. The safety system for the limit rotational speed is to be non-disconnectable. The indication signal is to be provided for the disconnected condition of the main machinery safety devices.

2.2.6 Failure of the remote control of the main propulsion plant is not to increase the speed of the ship, reverse the thrust of the propeller or unintentionally start up the main engine and also it is to be possible to stop immediately the machinery from the remote control station.

2.2.7 In case of fails in power supply of control systems, the change-over from one source of power to another is to be effected automatically or manually from the control station.

2.2.8 The possibility of simultaneous control from different stations is to be eliminated. Use of interconnected controls at navigating bridge wings and spaces is allowed.

2.2.9 If there is more than one control station, an indicator is to be fitted at each station showing from which station the installation is controlled. The change-over of control between stations on the navigating bridge and in the engine room is to be possible only from the navigating bridge.

2.2.10 Where the remote automated control for the main machinery is provided, the number of successive automatic attempts to produce a start is to be limited in order to keep enough air pressure for starting. The lowest air pressure still sufficient for starting the main machinery is to be signalled.

2.2.11 Where the remote automated control for the thrust vectoring of rudder-propeller, water-jet, cycloidal-propeller or bow-thruster installations there are to be two remote automated control systems, each independent of the other. Where there are two or more rudder-propeller, water-jet or cycloidal-propeller installations that are independent of each other the second remote automated control system may not be provided if the ship retains the manoeuvrability required by Section 2, Part III "Equipment, Arrangements and Outfit".

2.3 AUTOMATED ELECTRIC POWER PLANTS

2.3.1 Technical characteristics of the shipboard electric power plant are to ensure continuous power supply in compliance with the following requirements:

.1 on ships where electric power is supplied by a single generator, control devices are to be provided to ensure:

automatic or remote starting of standby generator if protection is actuated and the main switchboard busbars are deenergized;

automatic disconnection of non-essential consumers in case of the generator overload;

.2 on ships where electric power is supplied by generators operating in parallel, provision is to be made for:

automatic starting of reserve generator, synchronization, taking over and distribution of load in case of overload of the running generators;

automatic disconnection of non-essential consumers to prevent an overload of the remaining generators in case one of them fails and is disconnected while ensuring propulsion, steerability and safety of the ship.

2.3.2 When the voltage in the ship's mains is restored after black-out, provision is to be made for automatic or remote sequential starting of essential auxiliaries to be effected in such a way that the electric power plant is not overloaded.

2.3.3 Prime movers of generators started automatically are to be provided with indicators to show that prime movers are ready to start immediately.

2.3.4 If the power is supplied by a shaft-generator, it is to be disconnected automatically when a diesel-generator is started and connected to the busbars of the main switchboard.

2.3.5 Controlled parameters of automated electric power plants (except emergency), measuring points, limit values of parameters and types of automatic protection and parameter indication are given in Table 2.11.9.

2.3.6 On agreement with the Register, the use of diesel generators provided with devices for remote starting and shutting-off of prime movers, synchronizing, switching on and load distribution from the wheelhouse, is allowed.

2.4 AUTOMATED BOILER PLANTS

2.4.1 The requirements of the present Chapter apply to boiler plants with oil-burning installations.

2.4.2 Steam boilers, if used, are to be fitted with automatic regulators of water level and steam pressure.

2.4.3 Provision is to be made for a remote shut-off of boiler plants from the main machinery control room or from the control station where continuous watch is kept.

2.4.4 Automatic oil-burning installations are to be so designed as to cut off oil supply to the burners under the following circumstances:

.1 absence of flame for not more than 5 s from the moment fuel oil supply begins;

.2 fuel oil viscosity being insufficient for atomization;

.3 lowering of parameters of steam or air intended for fuel oil atomization;

.4 ventilation of the furnace is insufficient.

2.4.5 Starting of boiler plants from cold condition and after being shut off by the protection system is to be possible from the local control station only.

2.4.6 The automation system of exhaust gas hot-water boilers is to provide change-over of a device regulating the direction of exhaust gas flow through the boiler or directly to the atmosphere depending on the temperature in the boiler.

2.5 AUTOMATED BILGE PLANTS OF MACHINERY SPACES

2.5.1 Depending on the water level in wells, the automated bilge plants are to put the relevant bilge pumps in operation. A signal for pump operation is to be provided.

2.5.2 If, on bilge pumps starting, the water goes on rising or does not fall, an alarm is to be given.

2.5.3 A separate sensor independent of sensors fitted to control bilge pumps is to be provided to signal the highest permissible level.

2.6 AUTOMATED COMPRESSOR PLANTS

2.6.1 Replenishment of starting air receivers to provide operation of the tyfon as well as the air to feed automation systems is to be automatic.

Automated compressors are to be also capable of being started and stopped from the wheel house or the main machinery control room.

2.6.2 Compressed air system is to be fitted with automatic drainage arrangement.

2.6.3 Air compressors are to be started automatically when the pressure in air receivers drops not lower than by 30 per cent of the rated pressure, and be shut off automatically when the pressure in air receivers reaches 97 to 100 per cent of the rated pressure.

2.7 AUTOMATED PUMPING PLANTS

2.7.1 On automated ships, provision is to be made for automatic starting of standby circulating pumps used for lubricating and cooling of engines and reduction gears, lubrication and priming of the shaft bearings in case of the main pump failure.

2.7.2 For pumps used for pre-starting priming of the main engines by lubricating oil, provision is to be made for remote starting and automatic shut-off upon completion of the engine starting.

2.7.3 The electric circuit of pumps of equal output is to make it possible to use each of them as the main pump.

2.8 EQUIPMENT ARRANGEMENT IN THE WHEELHOUSE

2.8.1 Means are to be provided for remote control of main and auxiliary machinery and propellers.

2.8.2 Provision is to be made for independent emergency shut-off of the main engine from the wheelhouse.

2.8.3 An alarm device is to be fitted to give a signal of malfunctions of machinery and plants in the machinery space.

2.8.4 Provision is to be made for indication of rotation speed and direction of the propeller as well as the pitch of the controllable-pitch propeller.

2.8.5 Provision is to be made for indication of engagement or disengagement of the clutch.

2.8.6 In the wheelhouse provision is to be made for separate signals: “Water in the machinery space”, “Fire in the machinery space”, “Alarm system failure”.

2.8.7 At the navigating bridge (and also in the main machinery control room), alarm is to be provided to warn of the maximum concentration of hydrocarbons in the pump rooms of oil tankers.

2.9 EQUIPMENT ARRANGEMENT IN THE ENGINE ROOM

2.9.1 A local control station is to be provided to control the main propulsion plant.

2.9.2 In the vicinity of the main propulsion plant control station, a panel is to be fitted for alarms and indication of the machinery installation parameters.

2.9.3 It is recommended to install controls of auxiliaries in the vicinity of the main propulsion plant control station.

2.10 ALARM, PROTECTION, INDICATION AND RECORDING SYSTEMS

2.10.1 Irrespective of the extent of automation and surveillance procedure adopted for the machinery, the alarm system is to give audible and visual signals at:

.1 controlled parameters reaching predetermined limit values;

.2 actuation of protection systems;

.3 power failure in the circuits of particular automation systems;

.4 start of emergency sources of power;

.5 automatic start of emergency machinery and installations.

2.10.2 The alarm system of machinery installation is to actuate visual and audible signals when the controlled parameters exceed the permissible values and the appropriate time delay. The signal is not to be actuated in case of momentary deviations of parameters caused by manoeuvring. Signals are to operate in the machinery space or the main machinery control room (if any) and in the wheel house.

2.10.3 In engineers' accommodation spaces, alarm device is to be fitted to give a common signal of malfunctions of machinery and plants in the machinery space.

2.10.4 Acknowledgement of one alarm is not to prevent another signal from being set off.

2.10.5 It is to be possible to switch off acoustic alarms after acknowledgement.

2.10.6 Visual alarm with acknowledgement is to be distinguishable from an alarm without acknowledgement.

2.10.7 Visual alarms is to remain visible until the fault has been remedied.

2.10.8 Failure in the alarm system is not to result in failure of the apparatus or installation being monitored.

2.10.9 Provision is to be made for the control of circuits of sensors for short circuit, circuit break and contact-to-frame fault.

2.10.10 The alarm system and indicators are to be supplied from two independent sources of electrical power. In case of one source failure, the automatic change-over to the other source of power is to be provided.

2.11 SAFETY, INDICATION AND REGULATION SYSTEMS

2.11.1 Safety systems of automated machinery are to be provided only for those parameters the deviation of which may cause serious damage or complete breakdown of the machinery.

2.11.2 Safety systems are to be activated automatically in case of failures which can lead to the critical state of machinery and equipment so that:

.1 to protect the affected equipment from an emergency condition by halting its operation;

.2 to temporarily adjust the work of the equipment to the occurred conditions (e.g., to slow down the operation);

.3 to warn a permanently-manned station to halt the operation of the equipment or to change the mode of its operation involving attending personnel.

2.11.3 Safety systems are to be independent of control, alarm, indication and logging systems.

2.11.4 Self-monitoring of safety systems is to be provided or it is to be possible to check that they are operating correctly.

2.11.5 Incremental transducer circuits of safety systems are to be designed according to normally closed circuit principle.

2.11.6 Provision is to be made for displaying the readings of indication systems in units normally used for the parameters, i.e. without recalculation.

2.11.7 The pressure and temperature of essential systems of the propulsion plant are to be regulated automatically.

2.11.8 Provision is to be made in accommodation and service spaces for a signalling system to call engineers to the machinery space put into operation manually from the control station or automatically where the alarm signal has not been acknowledged.

2.11.9 Controlled parameters of plants and systems measuring points, limit values of parameters, and types of automated protection and indication are given in Table 2.11.9.

Table 2.11.9

Nos	Controlled parameter	Measuring point	Alarm for limiting values of parameters	Automatic protection	Indication at main control station [1]	Comments
1	**Main internal combustion engines**					
1.1	Lubricating oil pressure	At engine inlet	Min	Shutdown	Continuous	—
1.2	Lubricating oil temperature	At engine inlet	Man	—	Continuous	—
1.3	Lubricating oil pressure differential	Filter	Max	—	—	—
1.4	Turbocharger lub.oil pressure	At bearing inlet	Min	—[2]	—	—
1.5	Coolant pressure or flow	At engine inlet	Min	Slowdown	Continuous	If independent lubricating oil pump is fitted
1.6	Coolant temperature	At engine outlet	Max	Slowdown	On call	—
1.7	Cooling seawater pressure or flow	In seawater cooling system	Min	—	Continuous	—
1.8	Exhaust gas temperature	In main pipiline	Max	—	—	—
1.9	Starting air pressure	At starting valve inlet	Min	—	Continuous	For reversible engines
1.10	Air pressure	Engine control system	Min	—	—	—
1.11	Scavenging air temperature	At scavenging air cooler outlet	Max	—	—	—
1.12	Fuel oil pressure	At inlet of fuel oil injection pumps	Min	—	On call	If independently-driven fuel oil trans-fer pumps are fitted

Table 2.11.9 — continued

Nos	Controlled parameter	Measuring point	Alarm for limiting values of parameters	Automatic protection	Indication at main control station [1]	Comments
1.13	Fuel oil viscosity (temperature)	At engine inlet	Max (Min)	—	—	If heavy fuel oil is used
1.14	Fuel oil level	Daily service tank	Min	—	—	—
1.15	Fuel oil leakage	High-pressure piping	Presence of fuel oil	—	—	—
1.16	Engine speed	—	Max	Shutdown	Continuous	—
1.17	Power supply to remote control, alarm and safety systems	At inlet of systems	No power supply	—	—	—
1.18	Hydraulic oil pressure in CP-propeller system	At filter autlet	Min	—	Continuous	—
1.19	CP-propeller hydraulic oil level	Header tank	Min	—	—	—
2	**Reduction gear**					
2.1	Lubricating oil pressure	At reduction gear inlet	Min	Shutdown	—	—
2.2	Lubricating oil temeperature	Reduction gear	Max	—	—	—
3	**Internal combustion engines for driving generators**					
3.1	Lubricating oil pressure	At engine inlet	Min	Shutdown	—	—
3.2	Coolant pressure or flow	At engine inlet	Min	—	—	—
3.3	Coolant temperature	At engine outlet	Max	—	—	—
3.4	Fuel oil leakage	High-pressure piping	Presence of fuel oil	—	—	—
3.5	Engine speed	Limiting governor	Max	Shutdown	—	—
3.6	Starting air pressure	At starting valve inlet	Min	—	—	—
4	**Ship mains**					
4.1	Voltage	Main switchboard	Min, max	—	Continuous	—
4.2	Insulation resistance	Main switchboard	Min	—	Continuous	—
5	**Starting compressors**					
5.1	Lubricating oil level	At compressor inlet	Min	Compressor shutdown	—	—
5.2	Air temperature	At compressor oulet	Max	—	—	—
6	**Tanks**					
6.1	Lubricating oil level	Daily service tanks	Min	—	—	For engines with dry crankcase
6.2	Fuel oil level	Daily service tanks	Min	—	—	—
6.3	Coolant water level	Expansion tank	Min	—	—	—
7	**Bilge plants**					
7.1	Water level	Bilge wells	Max, min	—	—	When remotely controlled
7.2	Emergency water level	Bilge wells	Max	—	—	Signal is brought out to wheelhouse
8	**Miscellaneous**					
8.1	Boiler plant protection system	Supply unit	Failure	Boiler shutdown	—	Necessary only with oil burning installations
8.2	Alarm system	Supply unit	Failure	—	—	—

[1] Or in the location from where machinery controlled (wheelhouse).
[2] Where ships have only one main engine, that engine is not to be shut down automatically.

PART XI. RADIO EQUIPMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to ships listed in 1.2.1.1 to 1.2.1.3 Part I "Classification" radio equipment of which is subject to the Register technical supervision, as well as to radio equipment intended for installation on board these ships.

1.1.2 The Register is entitled to impose additional requirements and in some cases to allow practicable and well-grounded deviations from the Rules.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations relating to general terminology of the Rules are given in Part I "Classification".

For the purpose of the present Part the following definitions have been adopted.

Starting period is the time necessary for radio equipment to become operational as measured from the moment of power supply from the source of power.

Additional channel is the channel which is listened to only in the absence of a signal at the priority channel.

Aerial gain is the ratio, usually expressed in decibels, of the power required at input of a loss-free reference aerial to the power supplied to the input of the given aerial to produce in the given direction the same field strength or the same power flux-density at the same distance. When not specified otherwise, the gain refers to the direction of the maximum radiation. The gain may be considered for a specified polarization.

Carrier power of a radio transmitter is the average power supplied to the aerial transmission line by transmitter during high frequency cycle under conditions of no modulation.

This definition does not apply to pulse modulated emissions.

Rated power of a radio transmitter is the minimum power within the frequency range of the transmitter transferred to the aerial or to the artificial aerial under normal operating and climatic conditions.

Peak envelope power of a radio transmitter is the power supplied to the aerial transmission line by a normally operating transmitter during high-frequency cycle corresponding to the highest crest of the modulation envelope.

Mean power of a radio transmitter is the power supplied to the aerial transmission line by a normally operating transmitter determined over the time sufficiently long compared with the lowest frequency encountered in the modulation. As a rule an interval of 1/10 s during which the mean power is maximum is to be selected.

Continuous watch means that the radio watch concerned is not to be interrupted other than for brief intervals when the ship's receiving capability is impaired or blocked by its own communications or when the facilities are under periodical maintenance, repair or checks.

Mobile radiotelephone station is a radiotelephone station providing operation while carrying and being fixed, and supplied from the own source of power.

Control station is a space of location of radio and navigational equipment necessary to provide safe operation, maneuvering and control of the ship, as well as of workstation providing the watch navigator with a commanding view and convenient for the equipment operation.

Priority channel is the channel which is listened to during the whole period of receiving of a signal at the additional channel.

Rescue unit is a survival craft (ship, boat, flying apparatus, etc.) with full complement of trained persons and equipment available for rapid carrying out search and rescue operations.

Public address system is an installation enabling the broadcast of the ship's Administration instructions into accomodation, service and public spaces as well as the ship's open decks.

Radio communication facilities are facilities intended for transmitting and receiving messages by means of radio waves.

Effective radiated power is the product of the power supplied to the aerial and the gain of this aerial with reference to a half-wave dipole in the prescribed direction.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The Register carries out technical supervision during development, manufacture, installation and operation of the following shipboard radio equipment:

.1 VHF radio station;

.2 portable VHF radio station;

.3 portable UHF radiotelephone station intended for internal service communication;

.4 public address system.

1.3.2 Prior to the beginning of manufacture of separate types of radio equipment the following documentation is to be submitted to the Register for review:

.1 technical task;

.2 technical description;

.3 schematic diagram with the list of components;

.4 general view drawing;

.5 wiring diagram;

.6 list of spare parts;

.7 tests program;

.8 installation (assembling) instruction.

1.3.3 Technical requirements for radio equipment, its arrangement and installation on board the ship not specified in the present Part, as well as the scope of technical supervision over this equipment are subject to special consideration by the Register in each particular case.

1.3.4 After installation on board the ship all radio equipment is to be duly adjusted and undergo mooring and sea trials according to the programs approved by the Register.

1.3.5 Installation on board ships of products manufactured not under the Register supervision is carried out on the ground of consideration of technical documentation (technical description, diagrams, test records, etc.) and performance of tests in compliance with the requirements of the present Part.

1.3.6 Every ship is to have the following technical documentation continuously available:

.1 description and maintenance manual of each type of radio equipment in Russian and in German or English;

.2 connection diagrams for all radio equipment corrected in accordance with all alterations introduced in the course of service.

2 RADIO EQUIPMENT OF INLAND NAVIGATION SHIPS

2.1 GENERAL

2.1.1 Radio equipment according to its content, technical characteristics, arrangement, assembly, operating and maintenance conditions is to provide the following types of radio communication during inland navigation:

receiving and transmitting of messages between the ship and shore-based radio station (port radio station);

receiving and transmitting of messages between ships (ship-to-ship network);

receiving and transmitting of navigational information;

ship's internal radio communication.

Besides, it is recommended to fit ships with radio stations which, in addition to the above mentioned, also provide receiving and transmitting of public correspondence.

2.1.2 Every ship engaged in inland navigation is to have the following equipment:

.1 VHF radio stations (2 sets);

.2 portable VHF radio station operating on the 15th, 16th and 17th channels (156,750, 156,800 and 156,850 MHz respectively), 2 sets;

.3 public address system;

2.1.3 In addition to the above, it is recommended to fit ships engaged in inland navigation with portable UHF radio stations intended for internal service communication, MF and HF radio station and with a radar transponder.

2.1.4 Radio equipment not specified in the present Section may be allowed for installation on board ships as the reserve one provided that it is not to unduly affect the operation of the main radio equipment. Operational characteristics of such equipment are to be not below those required in the present Rules for the main equipment. Installation of additional equipment is to be agreed with the Register.

2.2 SOURCES OF POWER

2.2.1 Electrical power for the radio equipment required by the present Part is to be supplied according to Table 2.2.4. In this case, provision is to be made for simultaneous charging the reserve source of electrical power.

2.2.2 Provision is to be made for visual and audible signalling system for switching of radioequipment to a reserve source of electrical power at the position from which the ship is normally navigated.

Electrical power is to be supplied to this signalling system from the emergency source of electrical power.

2.2.3 The reserve source of electrical power is to be capable of providing the electrical power to the radio installations connected to it for at least one hour.

Table 2.2.4

Nos	Radio equipment	Main source	Emergency source	Reserve source to supply radio installation	Feed sources built in radio equipment
1	VHF radio station[1]	+	+[2]	+	—
2	Public address system[4]	+	+	—	—
3	Portable VHF radio station	—	—	—	+[3]
4	Portable UHF radio station intended for internal service station is to communication	—	—	—	+
5	Radar transponder	—	—	—	+

[1] At least one VHF radio station is to be supplied from the reserve source of electrical power.
[2] Only in case of diesel generator is used as an emergency source of electrical power.
[3] Primary batteries are to have sufficient capacity to ensure 8 h operation at its highest rated power with a duty cycle of 1:9. This duty cycle is defined as 6 s — transmission, 6 s — reception above squelch opening level and 48 s — reception below squelch opening level.
[4] Required for passenger ships and for ships where no other means is provided to broadcast orders to the crew.

2.2.4 The reserve source of electrical power is allowed to supply only the radio equipment specified in Table 2.2.3, emergency lighting lamps within the radio room and portable electrical lamp.

2.2.5 The capacity of the reserve source of electrical power accumulator battery is to be determined as a sum of three values: 1/2 of the current consumed for transmission, the current consumed for reception by each radio station (refer to Table 2.2.4), and the current consumed for additional loads.

In this regard, to compensate the possible loss of the accumulator battery capacity in service it is recommended to provide the 1,4 increase of the reserve source of electrical power capacity as compared with that of the designed.

2.2.6 If the reserve source of electrical power consists of rechargeable accumulator battery, an automatic charging device is to be provided, which is to be capable of recharging the accumulator battery within 10 h.

2.2.7 The capacity of the accumulator battery is to be checked at intervals not exceeding 12 months, at mooring.

2.3 AERIALS

2.3.1 On every ship VHF receiving and transmitting aerials to provide the operation of every fixed VHF radio station are to be erected, as well as receiving and transmitting aerials for the HF range if the ship's radio station operates within this range.

It is allowed to use common aerials if it is capable to provide independent operation of receiving and transmitting paths of radio stations.

2.3.2 As far as practicable, one common aerial is to be provided for all general broadcasting receivers fitted on board the ship. The use of aerials assigned for radio communication and radio navigational facilities as aerials for general broadcasting receivers is not allowed.

2.4 SPARE PARTS, SUPPLY AND DOCUMENTATION

2.4.1 The amount of spare parts and tools necessary for the minimum repair is to be provided on every ship according to the manufacturer's recommendations.

2.4.2 Every type of radio equipment is to be provided with technical documentation for maintenance and repair. The relevant documentation is to be duly kept in the regular place.

2.5 MAINTENANCE

2.5.1 On ships engaged in inland navigation the serviceability of radio equipment is to be ensured by shore-based maintenance and repair.

3 SPACES FOR RADIO EQUIPMENT AND CABLING

3.1 GENERAL

3.1.1 All the required radio equipment is to be located in the control station.

3.1.2 Every radio station is to:

.1 be so located that no harmful interference of mechanical, electrical or other origin affects its proper use, and so as to ensure electromagnetic compatibility and avoidance of harmful interaction of radio installation with other equipment;

.2 be so located as to ensure the maximum possible degree of safety and operational reliability;

.3 be protected against harmful effects of water, extremes of temperature and other adverse environmental conditions.

3.1.3 Radio communication facilities installed in compliance with the requirements of 3.1.1 are to be arranged at a place convenient for maintenance provided with a small table or sliding (hinged) shelfboard for writing down notes. The table for navigational plotting may be used for this purpose. The clock providing the indication of hours, minutes and seconds clearly distinguished from the operating position of the radio operator under any lighting conditions, as well as the main illumination and illumination supplied from the reserve source of electrical power is to be provided near this equipment.

3.1.4 The equipment of radio communication facilities is to be so installed that the magnetic field produced by it is not influence the ship's magnetic compass readings in excess of the permissible rates.

3.1.5 Controls of VHF radio stations are to be located in the control station near the radar display unit (station) so that immediate access is possible at all times, and while using them the operator may face the ship’s bow.

3.1.6 Illuminating lamps built in the radio equipment and intended for the arrangement on the navigating bridge are to be provided with luminous intensity control facilities.

3.1.7 All radio equipment as well as the reserve source of electrical power are to be so located on the ship that its operational efficiency is in no way impeded by the ship being submerged to the level of the deck where it is arranged.

3.1.8 All ship spaces intended for installation of radio receiving and transmitting apparatus are to have metal or metal-coated bulkheads. Metal or metal-coated ceilings and decks are to be electrically connected with one another and to the hull of a ship, with continuity of screening being preserved. On non-metal ships the screening metal sheathing is to be electrically connected to a keel plate or to specially made earthing arrangement.

3.1.9 All radio equipment is to be so installed that it is readily accessible for maintenance and repair on board the ship.

3.1.10 Radio equipment is to be securely fastened and is not to shift notwithstanding the angles of heel and trim of the ship or severe bumps and shaking likely to occur under service conditions.

3.1.11 The length of cables leading to separate radio apparatus is to be minimum. The distance between separate radio apparatus and between the apparatus and bulkheads is to be not less than 30 mm.

3.2 ACCUMULATOR BATTERY ROOM

3.2.1 If, due to its charging capacity, the accumulator battery of the reserve source of electrical power (refer to 13.2.1, Part IX "Electrical Equipment") cannot be installed in the inner compartments of the ship, it is to be installed in a special compartment (accumulator battery room) or in the outside boxes or cabinets provided the following applicable requirements are complied with.

The accumulator battery room which is intended for installation of accumulator batteries used for feeding the reserve source of electrical power is to be located on or above the navigating bridge deck level in such a place that the length of the cables leading to radio equipment does not exceed 15 m. The arrangement of the accumulator battery is to comply with the requirements of 13.2, Part IX "Electrical Equipment". In this case, the navigating bridge deck level means the ship control station level in the non-raised position.

3.2.2 The construction of the accumulator battery room as well as its systems of heating and ventilation are to comply with the requirements of Part VII "Systems and Piping" and Part IX "Electrical Equipment".

3.2.3 The accumulator battery room is to be provided with electric lighting complying with the requirements of Part IX "Electrical Equipment".

3.2.4 The accumulator battery room is to be provided with racks for placing accumulator batteries and sectional recess for storing distilled water and electrolyte. The top surface of the first row rack is to be at least 100 mm above the deck.

3.2.5 Degree of protection of accumulator battery boxes (cabinets) installed on the open deck of the ship is not to be below IP46 and placed at a height of at least 100 mm above the deck.

The design, heating and ventilation systems of accumulator battery boxes are to comply with the requirements of Part VII "Systems and Piping" and Part IX "Electrical Equipment".

3.2.6 Accumulator batteries are to be electrically insulated from the ship's hull.

3.2.7 Accumulator batteries are to be so located and installed as to ensure:

.1 the highest degree of service;

.2 a reasonable lifetime;

.3 a reasonable safety;

.4 that when charged to the rated capacity, accumulator batteries provide the time of operation required by the present Part irrespective of weather conditions;

.5 service conditions within the manufacturer's specifications.

3.3 ARRANGEMENT OF PORTABLE VHF RADIOTELEPHONE STATION

3.3.1 The portable VHF radiotelephone station is to be kept in the control station or in any other compartment which is kept unlocked while the ship is at sea, if such compartment provides quicker and more convenient transfer of the station to any lifeboat or any liferaft.

The station is to be kept at a prominent place. All fastenings, if any, intended for securing the station at the place of storage are to be designed for urgent releasing without applying tools.

3.4 ARRANGEMENT OF PUBLIC ADDRESS SYSTEM EQUIPMENT

3.4.1 Public address system loudspeakers are to be arranged so as to be capable of relaying command microphone posts to all accommodation and public spaces as well as to the open decks of the ship at the designed load and the maximum amplification. The minimum audio volume level is to exceed the noise level in all these places at least by 20 dB.

3.4.2 The main command microphone post and the amplifiers of the public address system are to be installed in a special room or in the control station.

3.4.3 Heating, lighting and ventilation of the ship public address system location is to comply with the requirements specified for the control station and regulated by Part XII "Navigational Equipment".

3.4.4 Loudspeakers installed in the ship's accommodation spaces are to be provided with volume adjusters and switches. The use of socket outlets is not allowed.

3.4.5 Apparatus operating megaphones (one-way loudspeakers intended for communication with nearby ships and with the shore) are to be installed in the control station. Megaphones are to be arranged above wheelhouses at places most convenient for providing their normal turning and sound spreading in any direction required.

3.4.6 Public address system is to comprise the two-way broadcast device for providing the duplex and simplex communication from the navigating bridge with at least three stations: the engine room, fore and aft anchor and mooring arrangements.

3.4.7 Every passenger ship is recommended to be provided with at least three main broadcasting lines:

.1 deck line intended for operating loudspeakers installed on the open decks of the ship;

.2 service line intended for operating loudspeakers fitted in the ship's crew accommodation and service spaces (cabins, mess-rooms, dining rooms, libraries, reading rooms, etc., including corridors and platforms adjacent to these compartments);

.3 passenger line intended for operating loudspeakers fitted in passenger accommodation and public spaces (cabins, dining rooms, libraries, reading rooms, restaurants, saloons, verandahs, cafes, refreshment rooms, etc., including corridors and platforms adjacent to these compartments).

3.4.8 Every passenger ship is to be provided with at least two command broadcast microphone posts providing commands broadcasting. One post is to be fitted in the control station and the other in the room intended for keeping watch while the ship is at port. On ships which have no special rooms for watch keeping, the command microphone post is to be fitted in the most convenient place close to the passenger gangway.

3.4.9 Every cargo ship fitted with public address system is to be provided with the broadcasting lines specified in 3.4.7.1 and 3.4.7.2.

3.4.10 Short circuit or break of one or several loudspeakers of the broadcasting line are not to result in the whole system failure.

3.5 CABLING

3.5.1 All cabling of radio equipment and protection measures against radio interference caused by the ship's electrical arrangements are to comply with the requirements of Part IX "Electrical Equipment" as well as with additions and amendments set forth in the present Section.

3.5.2 The power supply of the radio equipment from the ship's mains is to be provided in accordance with the requirements of Part IX "Electrical Equipment".

3.5.3 The distribution board of the radio station is to be supplied from the main and emergency distribution boards by two independent feeders.

The distribution board of the radio station is to be provided with the switching and protective equipment for connection and protection of the appropriate radio equipment in each outgoing feeder.

Connection of consumers not relating to the radio equipment to the radio station feeder is not allowed.

3.5.4 The space (or enclosure) intended for radio equipment is to be provided with an indication of the ship's mains voltage.

3.5.5 All cabling included into the cabling network of shipboard radio communication facilities and public address system is to be made by means of screened cables, with continuity of screening being preserved.

3.5.6 The armour of cables is to be earthed at those places where the cables enter the ship's spaces in which radio-receiving apparatus is installed.

3.5.7 Metal cases of radio apparatus are to be electrically connected to the ship's hull as directly as possible. The screening armour of cables, where the cables enter the equipment, is to be electrically connected to the cases of the equipment.

3.5.8 High frequency cables in cargo holds, on the open deck and on the masts are to be laid in compliance with the requirements of Part IX "Electrical Equipment".

3.5.9 Insulation resistance of every laid cable disconnected at both ends from the radio equipment is not to be less than 20 Mohm, irrespective of the cable length.

4 AERIALS AND EARTHING

4.1 GENERAL

4.1.1 It is allowed to fit the ship with an aerial of any type recommended by the manufacturer of appropriate radio equipment and which provides the highest operational efficiency of the radio equipment in accordance with its purpose. Aerials are to be capable of withstanding the effects of mechanical and climatic factors encountered under the ship's service conditions. The mast-type aerials and other aerials of self-supporting type are to satisfy the tests within the limits of possible use of the test benches and chambers.

4.1.2 All the ship's aerials are to be capable of withstanding a pressure of air flow having a speed of 60 m/s in any directions, the ship's speed and other factors being not considered.

4.1.3 Wire aerials are to be manufactured of flexible stranded aerial wire made of copper-based alloy. To satisfy the requirements of 4.1.2, when calculating the minimum diameter of the aerial wire, the aerial sag is to be taken as equal to 6 per cent of the aerial span.

4.1.4 Each horizontal aerial wire is to be made of one-piece stranded wire. Where the aerial construction does not permit to make the down-lead and the corresponding horizontal aerial of one-piece wire, the connection of the horizontal aerial wire with the down-lead is to be made by means of splicing or by means of compression couplings providing the reliable electrical contact.

4.1.5 The down-lead wire of an aerial is to be secured at the lead-in to a guy fitted with insulators; then the down-lead wire is to be connected to the lead-in by means of a copper or brass thimble. The connection of the thimble with the down-lead wire is to be effected by soldering or cold pressing.

4.1.6 The construction of transmitting aerials is to prevent any possibility of corona-effect.

4.1.7 The aerial rigging is to ensure the possibility for quick lowering and hoisting as well as tension regulation of the wire aerial without man hoisting to the mast top.

4.1.8 Halyards used for hoisting wire aerials are to be flexible halyards made of material approved by the Register. Hoisting halyards used on ships carrying readily flammable cargoes are to be made of non-combustible materials and their securing positions are to be outside a dangerous space. If steel halyards are used in this case, they are to be reliably electrically connected to the ship's hull.

4.1.9 Special high frequency insulators rated for corresponding operational voltage and mechanical load are to be used for the aerial insulation.

4.1.10 The aerial insulation resistance in relation to the ship's hull under normal climatic conditions is not to be less than 10 Mohm, and under excessive humidity, not less than 1 Mohm.

4.1.11 Mast-type aerials and aerials of other types consisting of some separate conducting units are to be so constructed that the value of contact resistance of any electrical connection does not change under the influence of mechanical loads and climatic factors encountered under service conditions.

4.1.12 The receiving aerials are to be so constructed and arranged that their interaction with all transmitting aerials and with one another is minimum.

4.1.13 Individual lengths of the horizontal and down-lead wires of the aerials are to be located at a distance not less than 1 m from funnels, masts and other metal objects of the ship. The distance between the horizontal wires of the aerial and the cap stay is to be, as far as practicable, not less than 3 m. The aerials are to be arranged so as to prevent touching the metal structures of the ship under any service conditions.

4.1.14 In oil/ore carriers, oil tankers and bulk carriers, gas carriers and chemical carriers all steel rigging of masts (shrouds, stays, whistle and siren guy ropes, cap stays, etc.) is to be broken up with insulators in such a way that the distance between the insulators is to be not less than 6 m, and the lowest insulator is to be not less than 3 and not more than 4 m from the deck. It is recommended to break up the rigging of every ship with insulators in order to minimize power losses while operating transmitters. Breaking up cap stays with insulators is mandatory for every ship.

4.1.15 The lowest ends of the standard steel rigging of masts and funnels are to be electrically connected to the ship's hull in compliance with the requirements of 4.4.8. All other rigging is to be insulated from the ship's hull or, if the fulfillment of this requirement is impracticable, is to be reliably electrically connected to the ship's hull by means of bronze or steel stranded wire of the adequate cross-section.

4.1.16 The aerials of general radio broadcasting and television receivers are to be arranged as far apart from all service purpose aerials as possible.

4.1.17 If the portable VHF radiotelephone station for service interior communications is stationary mounted, its aerial height is not to exceed 3,5 m above the navigating bridge deck.

4.1.18 The aerials of self-supporting type exceeding above the ship's superstructure are to be of the collapsible type providing the quickest possible their collapsing or lowering down to the deck level, this operation being controlled from the wheelhouse.

4.1.19 Wire aerials fixed on the collapsible masts are to be so constructed that it is not necessary to have them previously lowered when the masts being collapsed and subsequently hoisted after the masts have been hoisted.

4.1.20 Every aerial not intended for constant switching to operational position is to be provided with a special commutating device fitted inside the compartment and capable of switching the aerial into operational, isolated and earthed positions.

4.1.21 The radio station having a remote control is to be provided with an automatic earthing gear to be used for the aerial when the apparatus is switched off. It is allowed to have manual remote control of this earthing gear from the radio station panel.

4.2 VHF RADIO STATION AERIAL

4.2.1 The VHF radio station is to be provided with a vertically polarized aerial.

4.2.2 The aerial of the VHF radio station is to be fitted at the maximum possible height so as to ensure effective receiving and transmitting of signals at all operating frequencies and to avoid obstructions in way of electromagnetic field propagation all round the horizon.

4.3 LEAD-IN AND INTERIOR WIRING OF AERIALS

4.3.1 Wiring of the transmitting aerials into interior spaces of the ship is effected through special lead-in fitted with insulators capable of withstanding the corresponding operational voltage, except when the interior wiring of an aerial is made by means of a high frequency cable.

4.3.2 The construction of the lead-in of the transmitting aerial is to provide the possibility of easy and ready connection and disconnection of the aerial, preferably, without applying any tools. The construction of the lead-in is to exclude any possibility of the corona-effect during the operation of the transmitter.

4.3.3 The leads-in of the transmitting aerials are to be, preferably, fitted at such places where they provide for the shortest possible run of aerial wiring in interior compartments from the lead-in to transmitters.

4.3.4 Feeders of transmitting aerials inside the radio room are to be screened; the aerial switches (commutators) are to be of a screened type.

4.3.5 Feeders of receiving aerials are to be made with high-frequency screened cables, with continuity of screening being preserved. In this case, all commutators, change-over switches, lightning arresters and other devices connected to such cables are to be of a screened type. Feeders are not to induce signal attenuation over 3 dB.

4.3.6 High-frequency screened cables of receiving aerials feeders are to be led directly to the open deck and connected to the receiving aerials at the sufficient height. This connection is to be made by means of special contact device of waterproof or hermetic design, providing for reliable electrical connection and access for control over its condition.

4.3.7 Every receiving aerial is to be provided with a special device capable of protecting the receiver lead-in against atmospheric discharges. If the matching system is fitted between the receiving aerial and high-frequency cable, the devices capable of protecting against atmospheric discharges are to be connected before the matching system lead-in (on the aerial side).

4.4 EARTHING

4.4.1 Depending upon the power of transmitters, the sectional area of the busbars and tappings is to be not below values indicated in Table 4.4.1. In all cases, where practicable, it is allowed to effect the operational earthing of each transmitter separately by connecting the earthing terminals of a transmitter to the nearest metal bulkhead by means of a copper busbar or a flexible conductor of the adequate sectional area.

Table 4.4.1

Power of transmitter, in W	Below 50	50 to 500	Above 500
Busbar sectional area, in mm^2	25	50	100

4.4.2 In transmitters with emissive power above 50 W, the electric connection of the earthing busbar (flexible conductor) to the transmitter case is to be made in at least two placed most widely apart.

4.4.3 Operational earthings of radio receivers are to be effected by means of a copper busbar or a flexible copper stranded wire with a sectional area of not less than 6 mm^2 run as directly as possible from each receiver to the main earthing busbar of transmitters or directly to the nearest metal bulkhead reliably connected to the ship's hull.

4.4.4 Operational earthings of radio communication facilities, command broadcast facilities and other radio apparatus are to be carried out in compliance with the requirements of the present Part for operating earthings of receivers and transmitters.

4.4.5 On non-metal ships the operational earthing is to be common for the shipboard radio equipment. In this case, the electrical contact of the earthing with water is to be effected by means of a tinned copper or brass plate of at least 4 mm thick and having an area of not less than 0,5 m^2 secured to the outside surface of the hull below the lightest draught of the ship. It is recommended to provide two such earthings; in such case, the contacting surface of each earthing plate may be reduced to half the above value.

Metal keel binding or anti-teredo metal plating of wooden ships may be used instead of specially provided earthing gear.

4.4.6 On non-metal lifeboats the earthing of the radio station is to be made with two tinned copper tapes of not less than 0,1 m^2, fitted to the right and to the left of the keel near the middle frame of the boat.

4.4.7 The connecting wires of protective earthing of the radio apparatus cases are to be as short as possible, but not more than 150 mm long.

4.4.8 Protective earthing of lower ends of standing rigging of masts and funnels are to be made by means of the strand of the guy rope itself or with flexible metal conductors. Such conductors are to be provided with special soldered thimbles which are to be secured to the metal hull of the ship by means of two screws or by welding. The spots of connection with the hull are to be stripped of the insulation to the metal and adequately protected against corrosion.

4.4.9 The total resistance of all electric connections of any earthing is not to exceed 0,02 ohm.

4.4.10 It is not allowed to use the earthing gear of radio equipment as a lightning arrester.

5 TECHNICAL AND OPERATIONAL REQUIREMENTS FOR RADIO EQUIPMENT

5.1 GENERAL

5.1.1 It is recommended to use special turn locks, wing nuts or latches, capable of being loosened without any tools applied instead of threaded fastenings for the purpose of securing drop and sliding frames, removable panels and doors to the cases of radio apparatus.

5.1.2 Non-secured drop and sliding frames of radio apparatus are to be fitted with safety locks capable of operating in both directions to prevent possible falling of frames out of the case.

Opening doors are to be fixed in the open position.

5.1.3 Securing gear of removable and drop-type panels of radio apparatus is to be of non-falling-out construction.

5.1.4 Reliable and effective operation is to be provided by amount of controls, their design and arrangement.

Controls are to be so located as to eliminate the possibility of accidental use.

5.1.5 The diagram and construction of equipment are to exclude any possibility of damage or any harm to service personnel as a result of wrong sequence in operating controls.

5.1.6 Controls and measuring instruments of radio apparatus are to be provided with distinct nameplates or conventional symbols designating their purpose and operation.

5.1.7 In all cases, the position of controls indicating "on", "start", "increase", etc., is to correspond to the setting of control handles upwards and from or to the right of the operator, turning the control knobs clockwise and pressing the upper or right-hand buttons. The position indicating "off", "stop", "decrease", etc., is to correspond to the setting of control handles down, towards or to the left of the operator, turning the control knobs counter-clockwise and pressing the lower or left-hand buttons.

The "on" position is to have light indication.

5.1.8 Calibration of principal dials, inscriptions, marks and positions of indicators and controls fitted on the apparatus is to be distinctly visible at a distance of 700 mm under the standard illumination intensity and normal eyesight.

5.1.9 The dials of basic instruments intended for measuring the current intensity in the aerial and in output stage of the transmitter as well as for measuring the ship's mains voltage are to be so calibrated as to make any correction factor unnecessary.

5.1.10 Radio apparatus in which a cathode-ray indicator is used are to be capable of providing possibility for image viewing both in the day time and at night.

5.1.11 Controls of radio apparatus are to be protected against mechanical damage likely to occur when the face panel is put on the plane surface.

5.1.12 The construction of all controls is to prevent spontaneous changing of their preset positions.

5.1.13 If the panel for digital input is provided, the keys, handles, etc., are to be arranged in compliance with the recommendations of International Radio Consultative Committee.

5.1.14 Provision is to be made for protection of radio equipment against current inrushes and over-voltage as well as accidental change in polarity of the source of power.

5.1.15 Earthing (connection to the hull) of the ship's mains and accumulator batteries in circuits of radio equipment is not allowed.

5.1.16 Insulation resistance of feeding circuits of radio equipment measured between conductors and in the case of the apparatus as well as between the windings of transformers is not to be below the rates given (Mohm):

Normal climatic conditions 20
Temperature 50 ± 2 °C. Relative humidity below 20 per cent 5
Temperature 40 ± 2 °C. Relative humidity 95 ± 3 per cent 1

5.1.17 Radio equipment is to generally be designed for power supply from the ship's mains not exceeding 250 V.

Radio equipment is to be designed so that its technical characteristics remain within the limits required by the present Part with the power supply long-term fluctuation in voltage in the ship's a. c. mains of ± 10 per cent and in frequency — of ± 5 per cent, as well as with supply voltage fluctuations of +30 per cent and -10 per cent from the rated values in case of power supply from the accumulator batteries or from the ship's d. c. mains.

Radio equipment is to remain operative at short-term variations of the ship's mains voltage of ± 20 per cent for a period of 1,5 s and frequency of ± 10 per cent for a period of 5 s. No signals from the ship's alarms is to be given in such cases.

5.1.18 All feeding circuits of radio equipment is to be fitted with readily replaceable fuses or circuit breakers.

5.1.19 All radio equipment is to be designed for shipboard operation under any service conditions and is to be capable of withstanding mechanical and climatic tests to at least standards given below:

.1 at rolling pitching and prolonged inclinations up to 45° with a rolling and pitching period of 7 to 9 s in two interperpendicular operational positions during 5 min;

.2 under vibration conditions in the frequency range of 2 to 100 Hz with an amplitude of ± 1 mm for frequencies from 2 to 13,2 Hz and an acceleration of 0,7 g (7 m/s²) for frequencies from 13,2 to 100 Hz in three interpendicular positions;

.3 under shock loads with an acceleration of 10*g* (100 m/s²), a pulse duration of 10 to 15 ms and a frequency of 40 to 80 bumps/min in three interpendicular positions with the total number of bumps not less than 1000.

Subject to the type of equipment, place of installation and the ship's area of navigation, shock resistance tests may be liable to special consideration by the Register;

.4 at a temperature of 55 ± 3 °C for the equipment designed to operate in the interior spaces and on the open decks of the ship during 10 to 16 h in the operating condition, and at a temperature 70 ± 3 °C in the idle condition during 10 to 16 h;

.5 at a relative humidity of air 95 ± 3 % and temperature of 40 ± 2 °C during 10 — 16 h;

.6 at a temperature of 15 ± 3 °C and 40 ± 3 °C (for the fixed equipment designed to operate in the interior spaces of the ship and on the open decks of the ship respectively) during 10 to 16 h in the operating conditions and at a temperature of 60 ± 3 °C in the idle condition during 2 h.

Radio equipment is to be mould growth resistant and capable of withstanding the effect of hoarfrost, dew and icing (for the equipment designed to operate on the open decks of the ship).

Portable and mobile radio equipment is to be capable of resisting the solar radiation.

Portable and mobile radio equipment is to be capable of resisting oil.

5.1.20 The degree of protection of the radio equipment arranged in the ship's spaces is to be not lower than indicated in Table 5.1.20.

5.1.21 Measures to isolate the radio reception from unwanted interference generated by the ship's electrical equipment are to ensure such receiving conditions that the activation of this electrical equipment does not cause a voltage rise of more than 20 per cent at each receiver output in comparison with the voltage rise caused by internal noise.

Table 5.1.20

Nos	Type of radio equipment	Installation site	Degree of protection
1	Leads-in of aerials	Anywhere in ship	IP00
2	Communicating devices of aerials and apparatus containing no high frequency	Enclosed spaces	IP20
3	circuits		
5	Radio apparatus, except specified in items 1 and 2	Enclosed spaces	IP21
6	Accumulator battery boxes	Open decks	IP46
	Radio apparatus, except specified in item 1	Open decks	IP56
	Two-way VHF radiotelephone apparatus and radar transponders	Survival craft	IP68

The radio equipment is to be in compliance with the following requirements ensuring electromagnetic compatibility on board ship:

.1 the level of conducted radio frequency disturbance on the power supply terminals is not to exceed the rates specified in Fig. 5.1.21.1;

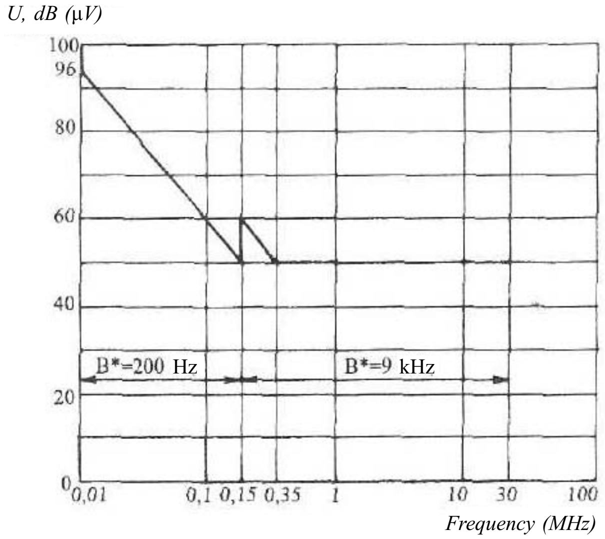


Fig. 5.1.21.1
Diagram of the permissible level of conducted radio frequency disturbance U, measured on the power supply terminals:
B^* – transmission band width

.2 the level of radiated disturbance (radiation limit) generated by radio equipment at a distance of 3 m from the enclosure port is not to exceed the values specified in Fig. 5.1.22.2;

.3 all radio equipment except portable is to be immune to conducted low-frequency disturbance if additional test voltages are superimposed on the equipment power supply voltage within a frequency range of 50 to 10 kHz;

for the equipment supplied from a d. c. power source – sinusoidal voltage, the applied value of which compises 10 per cent of the rated voltage value;

for the equipment supplied from an a. c. power source – sinusoidal voltage, the applied value of which

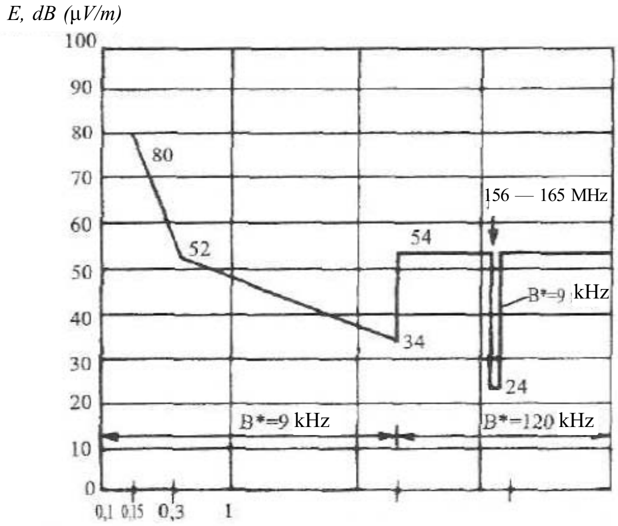


Fig. 5.1.22.2
Diagram of the permissible level of radiated disturbance (radiation limit) generated by radio equipment E, measured at a distance of 3 m from the enclosure port;
B^* – transmission band width

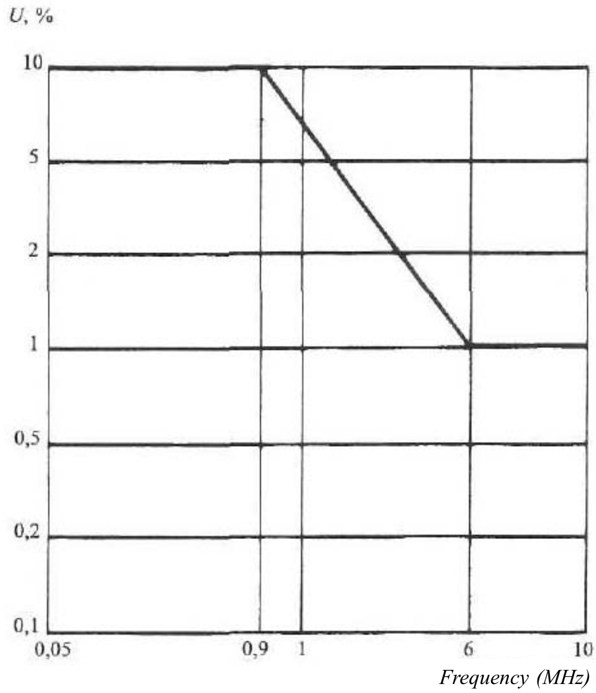


Fig. 5.1.21.3
Diagram of the test voltage obtained as a result of the test for the immunity to low-frequency conducted disturbance

varies in comparison with the rated voltage value depending on the frequency as shown in Fig. 5.1.21.3;

.4 all radio equipment except portable is to be immune to the conducted radio frequency disturbances induced in power, signal and control lines by the following test sinusoidal voltages:

3 V r. m. s. amplitude swept over the frequency range 10 kHz to 80 MHz;

10 V r. m. s. amplitude at spot frequencies: 2 MHz; 3 MHz; 4 MHz; 6,2 MHz; 8,2 MHz; 12,6 MHz; 16,5 MHz; 18,8 MHz; 22 MHz and 25 MHz.

Amplitude modulation at 400 Hz+10 per cent to a depth of 80 per cent ± 10 per cent is to be used;

.5 radio equipment is to be immune to radiated radio frequencies if it is placed in a modulated electric field of strength 10 V/m swept over the frequency range 80 MHz to 2 GHz. The modulation is to be at 400 Hz +10 per cent to a depth of 80 per cent ± 10 per cent;

.6 all radio equipment except portable is to be immune to fast transients on a. c. power, signal and control lines if the test voltage pulses with the following characteristics are applied:

amplitude 2 kV and repetition rate 2,5 kHz differential on a. c. power lines;

amplitude 1 kV common mode and repetition rate 5 kHz on signal and control lines. The rise time of the test signal is to be 5 ns (value between 10 per cent and 90 per cent), and width is to be 50 ns (50 per cent value);

.7 all radio equipment except portable is to be immune to slow, high-energy surges on a. c. power supplies if the pulses of the following characteristics are applied to the power lines: 2 kV — line/earth, 1 kV — line/line.

The rise time of the test signal is to be 1,2 μs (value between 10 per cent and 90 per cent), the width — 50 μs (50 per cent value) and the repetition rate — 1 pulse/min;

.8 all radio equipment except portable is to be immune to power supply failure in case of a power supply break of a 60 s duration. There is to be no corruption of operational software or loss of essential data;

.9 radio equipment is to be immune to electrostatic discharge. The levels of the test discharge voltage are the following: 6 kV for contact discharge and 8 kV for air discharge.

5.1.22 The ambient noise level produced by radio apparatus during its operation is not to exceed 60 dB.

5.1.23 Any equipment to be installed near the magnetic compass is to be provided with clear inscriptions indicating the minimum safe distance on which it can be installed from the compass.

5.1.24 Access to all current-carrying parts of radio apparatus, except aerial leads-in and earthing wires is to be allowed only after opening the case. Where the opening of the case is carried out without applying any tools, then, after each opening, no unprotected conductor of radio apparatus is to remain under the voltage over 250 V relative to any other conductors or earth. The capacitors mounted in the circuits of more than 250 V are to be automatically discharged to the voltage of 250 V and less.

5.1.25 The circuit and construction of radio apparatus are not to exclude the possibility of carrying out tests of it while in operation, with the case remaining open. Adequate protection of the operating personnel against electric shock in circuits of more than 250 V is to be provided.

5.1.26 All radio apparatus cases are to be fitted with terminals for connecting the earthing wire.

5.1.27 All metal parts mounted on the outside of radio apparatus case are to be earthed.

5.1.28 The connection of all cables to radio apparatus is to be carried out, with continuity of screening being preserved. The screening metal sheathings of cables are to be electrically connected to the apparatus cases. Provision is to be made for mechanical securing of cable to the apparatus case.

5.1.29 Radio equipment is to be so designed that replacement of its main units can be easily made without special tuning.

5.1.30 Each type of radio equipment is to be designed for being operated by one person.

5.1.31 It is recommended to provide radio apparatus and remote controls with devices capable of signalling any failure or critical operating conditions as well as switching on power supply.

The colours adopted for light signalling system are to comply with the requirements of 4.6.5.1, Part IX "Electrical Equipment".

5.1.32 All interior wiring electric connections of radio apparatus are to be of screw, socket outlet or no-acid hot soldering kind, or of any other kind approved by the Register.

5.1.33 All screw connections of the interior wiring as well as of structural parts of radio apparatus the loosening of which is likely to disturb the apparatus parameters are to be strong and provided with special locking devices to prevent their getting loose.

5.1.34 The construction of plug-and-socket connections used in radio apparatus is to exclude any possibility of their wrong connection. Measures are to be taken to prevent wrong insertion of plugs into sockets not intended for their connection. Projecting contacts of plug-and-socket connections are to be not live when being in “off” position.

5.1.35 The voltage value between the contacts of microphones and headphones (between wires) as well as between them and the earth is not to exceed 50 V.

5.1.36 Radio equipment is to have distinct markings containing the following information, at prominent places:

.1 manufacturer’s data;

.2 radio equipment type number or the name under which the radio equipment has passed type tests;

.3 radio equipment serial number;

.4 year of manufacture;

.5 type of current and supply voltage;

.6 safe distance between radio equipment and magnetic compass.

5.1.37 Interior components of radio apparatus are to have distinct and indelible markings corresponding to those of schematic and wiring diagrams. It is allowed to label the markings of small components on the frames (chassis) and screens of corresponding units as well as on enlarged photos attached to the description. Output terminals of radio apparatus are to be clearly labelled to indicate their purpose; power supply circuits are to have voltage and polarity markings.

5.1.38 Inscriptions characterizing technical parameters and other data fixed on the radio apparatus are to be located at prominent places.

5.2 GENERAL REQUIREMENTS FOR EQUIPMENT OF RADIO COMMUNICATION FACILITIES

5.2.1 The equipment of radio communication facilities is to be capable of transmitting and receiving radio alerts for distress, urgency and safety in the shortest possible time. To fulfil the above purpose the equipment is to comply with the following requirements:

.1 switching on power supply of the equipment is to be performed by one step manipulation only;

.2 starting period of transmitters and receivers is not to exceed 1 min;

.3 frequency retiming period of radio apparatus is to be as short as possible, but it is not to exceed 15 s. Emissions are not to be produced during the frequency returning period;

.4 switching over from transmission to reception and vice versa, while using shipboard radio communication facilities, is to be effected automatically.

5.2.2 Frequency tolerance of transmitters and receivers is not to exceed the values given in Table 5.2.2.

Table 5.2.2

Nos	Frequency range, in kHz	Radio communication facilities	Permissible frequency tolerance[1], in Hz
1	10000-470000	VHF and UHF radiotelephone stations and radio installations for survival craft	10
2		Transmitters and receivers: within 156-174 MHz range Outside 156-174 MHz range	50
3		Transmitters for interior communication within 450-470 MHz range	5

[1] Data in million parts of frequency.

5.2.3 All shipboard VHF radio station transmitters are to be designed for continuous operation during at least 6 hours, the ratio of the total emission duration to the pause duration being 2:1.

The two-way VHF radiotelephone apparatus intended for survival craft is to be capable of continuous operation during 8 hours, when operating cycle being 1:9.

For frequency-modulated maritime mobile radiotelephone equipment which operates above 30000 kHz, the mean power of any spurious emission falling in any other international maritime mobile service channel, due to products of modulation, is not to exceed 10 μW and the mean power of any other spurious emission on any discrete frequency within the international maritime mobile service band is not to exceed 2,5 μW.

5.2.4 Unwanted frequency modulation of the carrier frequency is to be sufficiently low to prevent harmful distortion.

5.2.5 A break of the aerial or its earthing to the ship's hull is not to cause any damage disturbing the normal operation of the transmitter.

5.2.6 All feeding circuits of receivers are to be fitted with devices for protection against radio interference produced by the ship's electrical equipment.

5.2.7 Input circuits of receivers are to be protected against voltage induced by operating shipboard transmitters.

5.2.8 Back radiation intensity value of receivers is not to exceed the permissible rates accepted in the national standards.

5.2.9 Receivers are to be provided with measuring instruments capable of checking their operating modes.

5.2.10 The construction of shipboard receivers is to provide the possibility for connecting a high frequency screened cable to the aerial terminal, with continuity of screening being preserved.

5.2.11 Receivers are to be capable of receiving radio signals during the pause of emission of their own transmitter. The time necessary for restoring full sensitivity of a receiver after the emission is not to exceed 0,1 s, with automated gain control being disconnected.

5.2.12 Loudspeakers mounted in the receivers are to be provided with switches.

5.2.13 All shipboard receivers are to be capable of 24-hour continuous operation.

5.2.14 The basic requirements for the ship's complex radio stations and remote control desks of shipboard radio communication facilities are as follows:

.1 when developing the ship's complex radio stations incorporating radio communication facilities housed in one sectionalized cabinet combined with the operator's table and combined remote control desks of shipboard radio communication facilities, the relevant requirements of 5.1 and 5.2 as well as requirements and recommendations given below, are to be met;

.2 clearly marked boundaries of sections intended for controls of each type of equipment are to be provided on the common control panel of the complex radio station. Controls of each equipment type are to be arranged as far as practicable in the sequence of their use from left to right or from up to down;

.3 access to the interior parts of the equipment incorporated in each section is to be possible without use of any tools;

.4 controls are to be arranged within the section of each type of equipment by separate groups at a certain distance from one another. Each group is to incorporate only such controls, which are functionally consistent with, or dependent on, one another.

In doing so, if any control is not consistent with other controls or does not functionally depend on them, it is to be considered as separate group.

All control grips are to be of the same type, size and shape within each group. However, in no group the use is allowed of the grip types utilized in any other group;

.5 there is to be no need to operate controls of the equipment using two hands simultaneously. Exception may be made only for controls intended for opening and closing housings of the equipment;

.6 buttons of the complex radio station relating to one group are to differ in colour from those belonging to any other group;

.7 all controls of complex radio station are to be provided with clear inscriptions indicating their purpose. Provision is to be made for each button for inscriptions, symbols or digits specifying their application.

5.2.15 The remote control desk of transmitter or radio station is to comply with the following requirements:

.1 all controls are to be provided allowing for radio communication without using the controls fitted directly on a receiver, transmitter or radio station;

.2 signalling system is to be provided to control the operation and give warning of faults of the apparatus;

.3 it is not to cause the apparatus parameters lying outside the limits specified by the present Part of the Rules and produce interference.

5.2.16 Radio equipment in addition to the requirements specified in the present Part of the Rules is to comply with the relevant requirements of International Radio Consultative Committee.

5.2.17 In case of using computers and computer systems in radio equipment they are to comply with the requirements of Part X "Automation".

6 RADIO COMMUNICATION FACILITIES

6.1 VHF RADIO STATION

6.1.1 The radio station is to provide radio communication using radiotelephony for the following purposes:

.1 safety;

.2 ship's operational requirements;

.3 public correspondence.

6.1.2 The radio station is to comprise:

.1 a radiotelephone transmitter/receiver including antenna;

.2 an integral control unit or one or more separate control unit (units);

.3 a microphone with a press-to-transmit switch, which may be combined with a telephone in a handset;

.4 an integral or external loudspeaker;

.5 an apparatus of the ship's automatic identification system.

6.1.3 VHF radio station is to be simple in maintenance.

6.1.4 The radio station is to be designated for maintaining radio communication on international frequencies in the band of 156 to 174 MHz by using classes of emission G3E in accordance with the Appendix to the present Part.

The interval between frequencies is to be 25 kHz.

6.1.5 The radio station is to be capable of operating:

.1 within the frequency range of 156,3 to 156,875 MHz on simplex channels;

.2 within the frequency range of 156,025 to 156,425 MHz for transmission and within the frequency range of 160,625 to 162,025 for reception on duplex channels.

6.1.6 The radio station is to have sufficient number of channels, but not less than five.

6.1.7 The maximum deviation of frequency corresponding to 100 per cent depth of modulation is to be as close to ± 5 kHz as practicable, but is not to exceed ± 5 kHz.

6.1.8 Frequency modulation is to have a pre-emphasis of 6 dB per octave with subsequent de-emphasis in the receiver.

6.1.9 The audio frequency bandwidth is not to exceed 3000 Hz.

6.1.10 The radio station is to be provided with a vertically polarized antenna. As far as practicable, an emission is to be omnidirectional in the horizontal plane.

6.1.11 The rated output power of a transmitter is to be not less than 6 W and not more than 25 W. In this regard, for the transmission of ship-to-ship and ship-to-port communications as well as for interior communication the power emission is to be automatically reduced down to 0,5 to 1 W with radio station changing over to the relevant channels. This reduction of power emission for safety related communications may be also specified by the requirements of the State (Port) Administration in the ship's area of navigation.

The output power when communicating the ship's automatic identification system signals is to be not more than 25 W.

6.1.12 The sensitivity of the receiver is to be equal to or better than 2 μV e.m.f. for a signal-to-noise ratio of 20 dB.

6.1.13 The output of the receiver is to be designed for a loudspeaker with power of at least 0,5 W. Simultaneously a micro-telephone handset may be used. Provision is to be made for switching off the loudspeaker without influence on the output sound power of the handset.

6.1.14 During duplex operation, emission the loudspeaker is to be switched off automatically. Provision is to be made for prevention of electric and acoustic feedback in the monophone.

6.1.15 Change of channel time is not to exceed 5 s.

The time taken to switch from the transmit to the receive condition, and vice versa, is not to exceed 0,3 s.

6.1.16 The receiver is to be provided with a manual volume control by which the audio output may be varied.

6.1.17 The 16th channel is to be fitted with a device capable of providing the minimum power of the loudspeaker equal to 50 mW when the manual volume control is set in zero position.

6.1.18 A noise eliminator is to be provided on the face panel of the radio station.

6.1.19 An on/off switch is to be provided for the entire VHF installation with a visual indication that the installation is switched on.

6.1.20 A visual indication that the carrier frequency is being transmitted is to be provided.

6.1.21 The radio station is to indicate the channel number to which it is tuned. Determination of the channel number is to be ensured under all conditions of lighting.

6.1.22 Controls of the radio station are to be fitted in the ship's control station. Controls from that position are to have priority if additional remote control units are provided. In this case, corresponding indication from one unit is to be provided in all control units.

6.1.23 The radio station is not to transmit during channel switching operation.

6.1.24 Operation of the transmitting/receiving control is not to cause unwanted emissions.

6.1.25 Provision is to be made for changing from transmitting to receiving by use of a press-to-transmit switch. Additionally, facilities for operation on duplex channels without manual control may be provided.

6.1.26 The bandwidth of the receiver on high (intermediate) frequency at a level of 6 dB is to be sufficient for receiving a signal with the maximum frequency deviation of ± 5 kHz.

6.1.27 Non-linear distortion factor of the receiver is to be not more than 7 per cent.

6.1.28 Adjacent-channel selectivity of the receiver is to be not less than 70 dB.

6.1.29 Intermodulation selectivity of the receiver is to be not less than 70 dB.

6.1.30 In the absence of scanning condition a device is to be provided capable of switching over the radio station to the 16th channel when a monophone is in its regular position.

6.1.31 Switching over from simplex to duplex operation and vice versa is to be effected automatically with the transition to the corresponding channels.

6.1.32 During simplex operation in the transit condition, the receiver is to be automatically switched off.

6.1.33 The radiotelephone station having multi-channel watch (scanning) facilities is to comply with the following requirements:

.1 be provided with the automatic scanning of a priority channel and an additional channel;

.2 if selection of a priority channel is not provided, the priority channel is to be the 16th channel;

.3 the channel numbers of both channels being scanned are to be clearly indicated;

.4 when the scanning facility is operating, transmitting is not to be possible;

.5 when the scanning facility is switched off, both transmitter and receiver are to be tuned automatically to the selected additional channel;

.6 provision is to be made for a manual control in order to switch for operation on the priority channel by a single control unit;

.7 scanning characteristics:

the priority channel is to be scanned with a sampling frequency of not less than once per two seconds;

if a signal is received on the priority channel, the receiver is to remain on this channel for a duration of that signal;

if a signal is received on the additional channel, the scanning of the priority channel is to be continued, thus interrupting receiving on the additional channel for periods as short as possible and not longer than 150 ms. The receiver is to be so constructed as to maintain its reliable operation during scanning of the priority channel;

in the absence of a signal on the priority channel and during receiving of a signal on the additional channel, the duration of each listening period on this channel is to be at least 850 ms;

means are to be provided to indicate the channel on which a signal is being received.

6.1.34 The apparatus of the ship's automatic identification system is to ensure the possibility of automatic transmitting of the above mentioned identification signal comprising the ten-digit identification number founded on the ten-unit error-detecting code. This signal is to be transmitted at the end of each transmitting, or at least every 5 minutes of the transmitting of more than 5 minutes duration. In this regard, each switching-off of a press-to-transmit switch is considered as the end of transmitting.

The apparatus of the ship's automatic identification system is to comply with the following requirements:

.1 not to unduly affect the operation of other radio and navigational equipment;

.2 during transmitting its output power is to correspond to the rated value;

.3 during transmitting there is to be no emission of any radiotelephone signals by microphone audio modulation;

.4 the possibility of switching off the apparatus from the VHF radio station is to be excluded, and moreover, the protection is to be provided against easy access to software and identification data with the purpose of their unauthorized amendment and alteration (replacement);

.5 the phase modulation with interval from 1300 Hz to 2100 Hz, relative to the sub-carrier frequency of 1700 Hz, modulation speed of 1200 Baud and modulation index not lower than 1,0, is to be used for the apparatus to be capable of initiating signals.

6.2 PORTABLE VHF RADIOTELEPHONE STATION

6.2.1 The station is to be used for on-board communications when operating on the appropriate frequencies.

6.2.2 The station is to comprise:

.1 an integral transmitter/receiver including a press-to-transmit switch;

.2 an integral control unit including a press-to-transmit switch;

.3 an integral microphone and loudspeaker;

.4 an integral apparatus of the ship's automatic identification system.

6.2.3 The station is to be designed so as to:

.1 be capable of being operated by unskilled personnel;

.2 be capable of being operated by personnel wearing gloves;

.3 be capable of single-handed operation (except for channel selection);

.4 withstand drops on to a hard surface from a height of 1 m;

.5 be watertight to a depth of 1 m for at least 5 min;

.6 maintain watertightness when subjected to a thermal shock of 45 °C during immersion;

.7 be resistant to seawater or oil.

6.2.4 The station is to:

.1 have no sharp projections which may damage survival craft;

.2 be of small size and light weight;

.3 be capable of operating in the ambient noise level likely to be encountered on board ships or in survival craft;

.4 have provisions for its attachment to the clothing of the user;

.5 be resistant to deterioration by prolonged exposure to sunlight;

.6 be painted yellow or orange or have a marking strip of yellow (orange) colour around the apparatus.

6.2.5 The station is to be capable of operation on the frequency of 156,75, 156,8, 156,85 MHz (VHF 15th, 16th and 17th channels respectively).

6.2.6 Simplex radiotelephone channels are to be used in the station.

6.2.7 The class of emission is to be G3E.

6.2.8 An on/off switch is to be provided with a visual indication that the radiotelephone is switched on.

6.2.9 The receiver is to be provided with a volume control.

6.2.10 A noise eliminator and a channel selection switch are to be provided.

6.2.11 Channel selection is to be easily performed and the channel selected is to be clearly discernible.

6.2.12 The effective radiated power is to be not less than 0,1 W and not more than 1 W.

6.2.13 The station is to be operational within 5 s of switching on.

6.2.14 The sensitivity of the receiver is to be equal to or better than 2 μV e.m.f. for a SINAD ratio of 12 dB. The immunity to interference of the receiver is to be such that the unwanted signals do not effect adversely the wanted signal.

6.2.15 The antenna is to be vertically polarized and, as far as practicable, be omnidirectional in the horizontal plane.

6.2.16 The loudspeaker audio output is to be sufficient to be heard in the ambient noise level likely to be encountered on board ships or in a survival craft.

6.2.17 In the transmitting condition, the output of the receiver is to be muted.

6.2.18 The radio station is to be provided with the apparatus of the ship's automatic identification system complying with the requirements of 6.1.35.

6.3 PORTABLE VHF RADIO STATION FOR INTERIOR SERVICE COMMUNICATION

6.3.1 The radio station is to provide interior communications on operating frequencies 457,525, 457,550, 457,575, 467,525, 467,550 and 467,575 MHz using the class of emission G3E. Where the apparatus is designed for the operation with interval between frequencies equal to 12,5 kHz, operating frequencies 457,5375, 457,5625, 467,5375 and 467,5625 MHz may be also used for interior communications.

6.3.2 The effective radiated power is to be not less than 0,2 W and not more than 2 W.

6.3.3 The deviation of frequency is not to exceed ± 5 kHz.

6.3.4 The audio frequency bandwidth is not to exceed 3000 Hz.

6.3.5 The radio station is to be provided with the apparatus of the ship's automatic identification system complying with the requirements of 6.1.34.

6.4 PUBLIC ADDRESS SYSTEM

6.4.1 Public address system is to be capable of providing the possibility for transmitting the service orders from the command microphone posts to all service, accommodation and public spaces as well as to open decks of the ship.

It is allowed to use the public address system for transmitting general radio broadcasting and sound-recording programs, if the priority of loud-speaking and command broadcasting is provided.

6.4.2 For the transmitting of the service orders all control of the public address system (switching on and off, commutation of the broadcasting relay lines, disconnection of programs and switching on a forcibly inserted broadcasting system) is to be carried out by remote control means directly from any of command microphone posts irrespective of the position of controls in all other command microphone posts.

6.4.3 The public address system is to be capable of being connected to at least three broadcasting lines.

6.4.4 The public address system is to include the main command microphone post intended for installation in the ship's command broadcasting centre, and at least two remote microphone posts. The main command microphone post is to be provided with means for audio control of broadcast quality in each broadcasting line.

6.4.5 Every command microphone post is to be fitted with light signalling system which is to be switched on simultaneously with the starting of the public address system.

The diagram of the remote control switching system is to be as simple as possible, preferably, without using relays.

6.4.6 Loudspeakers installed in accommodation spaces of the ship are to be fitted with volume controls.

6.5 HF RADIO STATION

6.5.1 HF wave band radio stations are to comply with the requirements of the present Chapter and the requirements of the Recommendation of ITU-P M.1173.

6.5.2 The technical and operational transmitter parameters are to comply with the characteristics given in Table 6.5.2.

Table 6.5.2

Parameter	**Numerical value**
Frequency band, kHz	1605 to 4000; 4000 to 18000
Mandatory fixed frequencies, kHz	2583; 4474
Number of frequencies in bands 1605 to 3800; 4000 to 18000	Discrete network with an interval of 100 Hz
Classes of emission	H3E, J3E and J2B
Standard antenna equivalent for determining the rated power in the range of 1605 to 4000 kHz:	
Capacitance, pf	300
Effective resistance, ohm	4
Standard antenna equivalent for determining the rated power in the range of 4000 to 18000 kHz:	
Effective resistance, ohm	75
Minimum peak output, W	30

6.5.3 The technical and operational receiver parameters are to comply with the characteristics given in Table 6.5.3.

Table 6.5.3

Parameter	Numerical value
Frequency band, kHz	1605 to 4000; 4000 to 18000
The receiver is to be capable of being tuned to frequencies within the above mentioned specified frequency band either discretely or smoothly, or by combination of both methods. Receivers tuned to fixed frequencies (not more than two frequencies, kHz) are permitted for use	2583; 4474
Classes of emission	H3E, J3E and J2B
Sensitivity, μV	not worse than 6
Selectivity:	
… at a level of 60 dB/ 6 dB:	
wide band	not more than 4
medium band	not more than 5
weakening of false channels, dB	not less than 60
Non-linear harmonic distortion coefficient, per cent	not more than 10

APPENDIX

Table

Channel number	Transmission frequency, in MHz		Communication ship-to-ship	Communication ship-to-shore	Navigational information
	Ship	Shore			
60	156,025	160,625			X
01	156,050	160,650			X
61	156,075	160,675			X
02	156,100	160,700			X
62	156,125	160,725			X
03	156,150	160,750			X
63	156,175	160,775			X
04	156,200	160,800			X
64	156,225	160,825			X
05	156,250	160,850			X
65	156,275	160,875			X
06	156,300	156,300	X		
66	156,325	160,925			X
07	156,350	160,950			X
67	156,375	156,375			X
08	156,400	156,400	X		
68	156,425	156,425			X
09	156,450	156,450			X
69	156,475	156,475			X
10	156,500	156,500	X		
70	156,525	156,525	Digital selective calling to initiate the distress alert		
11	156,550	156,550		X	
71	156,575	156,575		X	
12	156,600	156,600		X	
72	156,625	156,625	X		
13	156,650	156,650	X		
73	156,675	156,675			X
14	156,700	156,700		X	
74	156,725	156,725		X	
15	156,750	156,750			
75	156,775	156,775		X	
16	156,800	156,800			
76	156,825	156,825			X
17	156,850	156,850			
77	156,875	156,875	X		
18	156,900	161,500			X
78	156,925	161,525			X
19	156,950	161,550			X
79	156,975	161,575			X
20	157,000	161,600			X
80	157,025	161,625			X
21	157,050	161,650			X
81	157,075	161,675			X
22	157,100	161,700			X
82	157,125	161,725			X
23	157,150	161,750			X
83	157,175	161,775			X
24	157,200	161,800			X
84	157,225	161,825			X
25	157,250	161,850			X
85	157,275	161,875			X
26	157,300	161,900			X
86	157,325	161,925			X
27	157,350	161,950			X
87	157,375	157,375			X
28	157,400	162,000			X
88	157,425	157,425			X
AIS1	161,975	161,975			
AIS2	162,025	162,025			

PART XII. NAVIGATIONAL EQUIPMENT

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to ships which navigational equipment is subject to the Register technical supervision, as well as to navigational equipment intended for installation on these ships.

Hydrofoils, air cushion vehicles, planing boats and other high-speed craft are to meet the requirements of the present Part, as far as it is reasonable and practicable.

1.1.2 The present Part specifies the technical requirements which navigational equipment are to comply with, as well as defines the compartments in which navigational equipment is to be located and the number of navigational instruments, appliances and devices and their arrangement on board the ship.

1.1.3 The requirements of the present Part are specified in accordance with the division of waterways into Zones described in Part I "Classification".

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 Definitions and explanations related to general terminology are given in Part I "Classification".

For the purpose of the present Part the following definitions have been adopted.

Watch navigator means any person who keeps watch on the navigating bridge, navigates, operates bridge equipment, manoeuvers the ship and continuously observes the environment, and is responsible for safe navigation.

Depth means the vertical distance from a sea level to the bottom.

Field of vision is the horizontal angle within which no obstructions interfere in an observation of the environment from a workstation on the navigating bridge.

Depth contour is a contour line connecting points of equal water depths on a chart.

Route monitoring means actions on navigation control along the pre-planned route.

Bridge wings are those parts of the bridge on both sides of the ship's wheelhouse which, in general, extend to the ship's side.

Lookout is one of the basic duties of the watch navigator carried out by sight and hearing as well as by all available equipment so as to make a full appraisal of the situation and of the risk of collision.

Homing is manoeuvring to steer the ship for the course, corresponding to the bearing for the given target, and keeping it to the course.

Navigation is the process of deciding, executing and maintaining course and speed of the ship in relation to waters and traffic while moving from one place to another.

Navigational instrument means the ship's navigational device intended for manual operation while taking decisions on navigational tasks.

Navigational equipment means the ship facilities with which the ship is equipped for taking decisions on navigational tasks.

Navigational device means a device intended to execute some functions on measuring navigational parameters as well as processing, storage, transmission, displaying and recording of the data while taking decisions on navigational tasks on board the ship.

Navigational appliance means the ship's facility intended for taking decisions on one or more navigational tasks.

Data medium is a means for data storage and reading using the appropriate equipment.

Generalized display means overlapped reproducing on a display of information from several navigational devices or systems.

Observation means a determination of the ship's position by measuring several navigational parameters.

Displaying means reproducing information from a navigational device, appliance or system on a display or other indicating device.

Control station means a space of location of radio and navigational equipment necessary to provide the safe operation, manoeuvring and control of the ship, as well as of a workstation providing the watch navigator with a commanding view and convenient for the bridge equipment operation.

Route planning means actions performed while planning a route or making decisions on attendant navigational tasks.

Waypoint means a point on the preset ship's track which symbol and co-ordinates are entered in a control program.

Workstation means an area of the control station having the relevant equipment for taking decisions on one or several navigational tasks.

Radar plotting is the whole process of target detection, tracking, calculation of parameters and display of information.

System electronic navigational chart (SENC) means a database needed for the chart display generation and other navigational functions.

Trunk for log and/or echo sounder is a special watertight compartment in the ship's hull below waterline provided with a watertight closure.

Navigator is a specially trained person navigating and manoeuvring the ship using the bridge equipment.

Electronic navigational chart (ENC) means the database standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain additional navigational information.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions concerning the procedure of technical supervision of navigational equipment are specified in Part I "Classification".

1.3.2 The following equipment is subject to the Register technical supervision during its manufacture and installation on board the ship:

.1 compasses;

.2 echo sounders;

.3 radars;

.4 rate-of-turn indicators;

.5 combined ship's control desks;

.6 integrated navigation systems;

.7 unified timing systems;

.8 ECDIS;

.9 ship's heading control systems.

1.3.3 Technical requirements for navigational instruments and devices, their location and installation on board the ship, which are not specified in the present Part as well as the scope of technical supervision of these appliances and devices are subject to special consideration by the Register in each case.

1.3.4 The navigational devices and appliances indicated in items 6 to 11 of Table 2.2.1 are subject to the Register technical supervision only in the form of checking their availability on board the ship.

1.3.5 To survey equipment for approval by the manufacturer the following documents are to be submitted:

.1 two copies of a product detailed technical description;

.2 two complete sets of installation and maintenance documents;

.3 two copies of a detailed Operation Manual;

.4 two copies of a summarized user's manual;

.5 test and measurement reports on the horizontal and vertical radiation pattern of the antenna.

1.3.6 The Register is entitled to select equipment from the production series at any time for check tests. If the tests reveal defects in the equipment, the Type Approval Certificate may be withdrawn. The Type Approval Certificate may be valid for a period of 10 years.

In the case of any modification made to equipment and software having Type Approval Certificate, the Type Approval Certificate is to be withdrawn. Whenever modifications are planned, details are to be sent to the Register in writing.

The Register is to decide whether the Type Approval Certificate still applies or whether additional tests or new survey for type approval are necessary.

1.3.7 Every ship is to be permanently provided with the following technical documentation:

.1 user's manual for each type of navigational equipment in Russian and in German or English;

.2 circuit diagrams of navigational equipment, corrected in accordance with all the alterations made in the process of operation.

2 NAVIGATIONAL EQUIPMENT OF SHIPS

2.1 LIST OF NAVIGATIONAL EQUIPMENT

2.1.1 In order to specify navigational devices and instruments to be installed on board the ship all inland navigation ships are subdivided into four categories:

category 1 — passenger ships;

category 2 — self-propelled cargo ships and tankers, tugs, pushers, push-tugs, cargo push-ships and icebreakers;

category 3 — ships navigated by one person on watch;

category 4 — high-speed craft.

2.1.2 Navigational devices and instruments to be installed on board inland navigation ships are specified in Table 2.1.2.

Table 2.1.2

Nos	Navigational equipment	Number for ships/category of ships			
		1	2	3	4
1	Compass[6]	1	1	1	1
2	Radar[6]	1[1]	1[1]	1[1]	1[1]
3	Rate-of-turn indicator[6]	1	1	1	1
4	Echo sounder[6]	1	1[2]	1[2]	1
5	Chronometer	1	1	1	1[3]
6	Anemometer	—	—	1[4]	—
7	Prismatic binocular 7×50	1	1	1	—
8	Graduated staff gauge	2	2	2	2
9	Inclinometer	1	1	1	1[3]
10	Outdoor thermometer	1	1	1	1[3]
11	Searchlight	1	1[5]	1[5]	—

[1] Inland ECDIS equipment which can be operated in navigation mode is to be regarded as radar equipment. The ECDIS equipment is to comply with the requirements of 4.10.
[2] It is recommended to provide push-tugs with portable supersonic echo sounder for the head barge being pushed.
[3] For manned ships only.
[4] For floating cranes only.
[5] An additional searchlight is required for tugs, pushers and push-tugs.
[6] Push-tugs and cargo push-ships intended for navigation within the roadstead or in port waters may be exempted from this requirement by the port authorities.

2.1.3 Navigational equipment required for ships of special design is subject to special consideration by the Register in each case.

2.1.4 Navigational equipment in excess of that required by the present Section may be installed on board the ship as additional equipment, provided it does not interfere with the normal use of the required navigational devices and instruments. Operational and technical characteristics of such equipment are to be not lower than those stipulated by the present Rules for the required navigational equipment. Installation of any equipment in excess of that required by the present Part of the Rules is subject to special consideration by the Register.

2.2 SOURCES OF POWER

2.2.1 All navigational equipment installed on board the ship is to be provided with power supply from the main and emergency, if an emergency diesel-generator is available, sources of electrical power and is to be automatically connected to the emergency source of electrical power in case of the main source of electrical power failure.

It is recommended to provided the radar with power supply from the emergency source of electrical power in case an accumulator battery (if it has a sufficient capacity) is used as the emergency source of electrical power.

The requirements for power supply of navigational equipment from the emergency source of power are specified in Part IX "Electrical Equipment".

2.2.2 The switchboard of navigational equipment is to be supplied from the main and emergency switchboards by two independent feeders.

2.2.3 All electrically-operated navigational devices and instruments are to be supplied by separate feeders from one common switchboard of navigational equipment.

2.2.4 Where some types of navigational equipment are designed for being fed from various voltages, such equipment is exceptionally allowed to be fed from other switchboards, provided they are located close to the principal switchboard of navigational equipment.

2.2.5 If some types of navigational equipment are fed from additional switchboards, such switchboards are to be fed from the corresponding sources of power through separate feeders.

2.2.6 The switchboard (switchboards) of navigational equipment are to be provided with switches, fuses or with circuit-breakers fitted in circuits leading to feeders.

2.2.7 If the rudder-position indicator is electric it is to have its own power supply by a separate feeder.

2.3 SPARE PARTS AND SUPPLY

2.3.1 Every ship is to be supplied with the minimum amount of spare parts, portable measuring instruments, tools and materials assigned for normal operation of navigational equipment installed in this ship.

2.3.2 Complete sets of spare parts, portable measuring instruments, tools and materials are to be in compliance with those recommended by the manufacturer of navigational equipment and specified in technical documentation thereto.

3 INSTALLATION AND ARRANGEMENT OF NAVIGATIONAL EQUIPMENT

3.1 GENERAL

3.1.1 The wheelhouse is to be located above all deck structures which are at the level of or higher than the freeboard deck and is to be arranged in such a way that the helmsman may at all times perform his task while the ship is under way.

3.1.2 Under normal operating conditions, sound pressure generated by the ship and measured at the level of the helmsman's head at the steering position is not to exceed 70 dB(A).

3.1.3 There is to be an adequately unobstructed vision in all directions from the steering position. The number of window frames is to be kept to a minimum and they are not to lie immediately forward of work-station of the helmsman.

3.1.4 The area of obstructed vision for the helmsman ahead of the ship in an unladen state with half of its supplies but without ballast is not to exceed two ship lengths or 250 m, whichever is less, to the surface of the water over an arc from abeam on either side through right ahead of the ship.

Optical and electronic means for reducing the area of obstructed vision is not to be taken into account during the initial survey of the ship.

To further reduce any area of obstructed vision, only suitable electronic devices are to be used.

3.1.5 The helmsman's field of unobstructed vision at his normal position is to be at least 240° of the horizon.

No window frame, post or superstructure is to lie within the helmsman's usual axis of vision.

Even in case where a field of unobstructed vision of at least 240° of the horizon is provided, the Register may require other measures and in particular the installation of suitable auxiliary optical or electronic devices if no sufficiently unobstructed view is provided towards the rear.

3.1.6 The height of the lower edge of the side windows is to be kept as low as possible and the height of the upper edge of the side and rear windows is to be kept as high as possible.

3.1.7 In determining whether the requirements in this Chapter for visibility from the wheelhouse are met, the helmsman is to be assumed to have a height of eye of 1650 mm above the deck at the steering position.

3.1.8 The upper edge of the forward facing windows of the wheelhouse is to be high enough to allow a person at the steering position with height of eye of 1800 mm a clear view to at least 10° above the horizontal at eye-level height.

3.1.9 In all weathers there is to be suitable means of providing a clear view through the windscreen.

3.1.10 The glazing used in wheelhouses are to be made of safety glass and have a light transmission of at least 75 per cent. To avoid reflection, the bridge front windows are to be inclined from the vertical plane, so as to form an outward angle of not less than 10° and not more than 25°.

3.1.11 The proper functioning of the rate-of-turn regulator is to be displayed at the steering position by means of a green indicating light.

3.1.12 There are to be the following indicators and monitoring devices at the steering position: rudder blade position indicator, the indicator of thrust vectoring of rudder-propeller, water-jet, cycloidal-propeller or bow thruster installations, the indicator of oil level in the hydraulic reservoirs and service pressure of the hydraulic system.

3.1.13 Any lack of or unacceptable variations in the supply voltage and an unacceptable decrease in the speed of rotation of the gyroscope are to be monitored and displayed at the steering position by indicating light.

The visual or audible alarm is to be actuated also in case of failure of the electrical supply for the steering control and for the drive units, as well as failure of the rate-of-turn regulator and of the required buffer devices.

3.1.14 The remote-control equipment for the entire steering system is to be installed in a permanent manner and be arranged in such a way that the course selected is clearly visible. If the remote control equipment can be disengaged, it is to be equipped with an indicating device displaying the respective operational condition "in service" or "out of service".

3.1.15 The steering position is to be equipped with an effective controllable system of heating and ventilation.

3.1.16 Monitoring instruments are to be easily legible. It is to be possible to adjust their lighting steplessly down to their extinction. Light sources are to be neither intrusive nor impair the legibility of the monitoring instruments.

3.1.17 There is to be a system for testing the warning and indicating visual and audible signals.

3.1.18 It is to be possible to clearly establish whether a system is in operation. If its functioning is indicated by means of an indicating light, this is to be green. Any malfunctioning or failure of systems is to be indicated by means of red warning lights. An audible warning is to sound at the same time that a red warning light lights up. Audible warnings may be given by a single, collective signal. The sound pressure level of that signal is to exceed the maximum sound pressure level of the ambient noise at the steering position by at least 3 dB(A).

3.1.19 The audible warning is to be capable of being switched off after a malfunction or failure has been acknowledged. Such shutdown is not to prevent the alarm signal from being triggered by another malfunction. The red warning lights are only to go out when the malfunction has been corrected.

3.1.20 Where a wheelhouse has been designed for radar navigation by one person, the helmsman is to be able to accomplish his task while seated and all of the display and monitoring instruments and all of the controls needed for operation of the ship are to be arranged in such a way that the helmsman may use them comfortably while the ship is under way without leaving his position or losing sight of the radar screen.

3.1.21 Ships with wheelhouses designed for radar navigation by one person are to be steered by means of a lever. It is to be possible to move that lever easily by hand. The position of the lever in relation to the longitudinal axis of the ship is to correspond precisely to the position of the rudder blades. It is to be possible to release hold of the lever in any given position without that of the rudder blades changing. The neutral position of the lever is to be clearly perceptible.

3.1.22 Where the ship is fitted with bow rudders or special rudders, particularly for going astern, these are to be actuated in wheelhouses designed for radar navigation by one person by special levers which meet the requirements of 3.1.20.

3.1.23 In wheelhouses designed for radar navigation by one person the radar screen is not to be shifted significantly out of the helmsman's axis of view in its normal position; the radar image is to continue to be perfectly visible, whatever the lighting conditions outside the wheelhouse; the rate-of-turn indicator is to be installed directly above or below the radar image or be incorporated into this.

3.1.24 On board ships and convoys whose wheelhouse has been designed for radar navigation by one person and exceeding 86 m in length or 22.90 m in breadth it is to be possible for the helmsman to drop the stern anchors from his position.

3.1.25 Where vessel wheelhouses have been designed for radar navigation by one person, reception from the ship-ship networks and that of nautical information is to be via a loudspeaker, and outgoing communications via a fixed microphone. Send/receive is to be selected by means of a push-button. It is not to be possible to use the microphones of those networks for the public correspondence network.

3.1.26 Where ship wheelhouses designed for radar navigation by one person are equipped with a radio telephone system for the public correspondence network, reception is to be possible from the helmsman's seat.

3.1.27 There are to be internal communication facilities on board ships with a wheelhouse designed for radar navigation by one person and on board passenger ships. It is to be possible to establish communication links from the steering position: with the bow of the ship or convoy; with the stern of the ship or convoy; with the crew accommodation; and with the boatmaster's cabin. Reception at all positions of these internal communication links is to be via loudspeaker, and transmission is to be via a fixed microphone. The link with the bow and stern of the ship or convoy may be of the radio-telephone type. Internal communication facilities on passenger ships are also be available in the operation rooms and, where there is no direct communication from the wheelhouse, in the access and evacuation areas for passengers.

All passenger areas are to be reachable via a loudspeaker system. The system is to be designed in such a way as to ensure that the information transmitted can be clearly distinguished from background noise. Loudspeakers are optional where direct communication between the wheelhouse and the passenger area is possible.

3.1.28 On high-speed craft, wheelhouses are to be arranged in such a way that the helmsman and a second member of the crew may at all times perform their tasks while the vessel is under way. The instruments for navigation, manoeuvring, monitoring and communication and other important operating controls are to be sufficiently close together to allow a second member of the crew as well as the helmsman to obtain the necessary information and to operate the controls and installations as necessary. The second member of the crew is to have his own radar screen (slave) at his workstation.

Both the helmsman and a second member of the crew are to be able to operate the mentioned installations without any hindrance, including when safety belts are properly worn.

3.1.29 The area of obstructed vision forward of the bow for the helmsman in a seated position is not to be more than one ship length irrespective of the amount of cargo.

3.1.30 The total arc of blind sectors from right ahead to 22,5° abaft the beam on either side is not to exceed 20°. Each individual blind sector is not to exceed 5°. The clear sector between two blind sectors is not to be less than 10°.

3.2 MAGNETIC COMPASS

3.2.1 Magnetic compass is to be installed on the upper bridge or in the control station.

The compass installation is to provide the possibility for taking bearings within the sector of 230°, i.e. 115° to each side from the direction right ahead.

3.2.2 Magnetic compass is to be installed adequately remote from magnetic and electromagnetic fields providing the accuracy of the magnetic compass readings.

3.2.3 Magnetic compass is to be so installed and secured that its vertical plane which passes through the lubber lines does not deviate from the centre line of the ship or its parallel plane by more than 0,5°.

3.2.4 Any appliance or equipment in the vicinity of magnetic compasses not provided in the design may be fitted only on agreement with the Register.

3.2.5 Every ship is to be provided with magnetic compass residual deviation table. Removal of magnetic compass deviation, determination of residual deviation and preparation of resulting residual deviation table are to be performed:

.1 after any alteration both in the ship's construction and in the ship's equipment causing the alteration of magnetic fields in the vicinity of the compass, as well as after electric arc welding operations;

.2 after the ship's long staying in case the position of the centre line relative to the magnetic meridian remains unchanged;

.3 when magnetic goods are being carried in quantities;

.4 after the ship's demagnetization by any method;

.5 in any case where residual deviation exceeds the values specified in 4.2.7.

3.3 GYROCOMPASS

3.3.1 The master gyrocompass is to be installed in the control station compartment or in any specially intended dry space protected from environmental harmful influence and complying with the following requirements:

.1 be as close as possible to the centre line of the ship and to the midship section at the level of one of the existing waterlines;

.2 be provided with main, emergency and portable electric lighting;

.3 be provided with means of two-way communication with the navigating bridge. For this purpose the communication is to be of two-way system or to be a part of the ship's control communication system in accordance with the requirements of Part IX "Electrical Equipment";

.4 instruments or equipment not related to the technical aids of navigation are not to be installed in the compartment;

.5 it is not allowed to lay pipelines through the compartment other than the pipeline of gyrocompass cooling system.

3.3.2 It is allowed to install on ships both a gyrocompass and a magnetic compass with electric remote transmission of dial readings and to use the same repeaters for both compasses. In this case a light signal "Repeaters switched to magnetic compass" are to be provided in the wheelhouse. This signal is to be automatically switched on when the repeaters are connected to the operation from the magnetic compass impulser.

3.4 ECHO SOUNDERS

3.4.1 The depth indicator is to be installed in the control station, in the place and at a distance providing its most convenient use and operation.

3.4.2 The transducers of the echo sounder are to be installed in the ship's bottom clear of its sides and ends in places least affected by the ship's vibration and at a distance which prevents them from being emerged out of water when the ship is rolling. In case no relevant data on mounting available from the transducer supplier, it is recommended to install the transducer at a distance of 0,1 to 0,5 of the ship's length from the stem, as measured along the plane of the waterline, which corresponds to the lightest service draught of the ship, and close to the centre line of the ship.

3.4.3 In the vicinity of the transducer there are to be no supersonic emitting devices of other instruments operating simultaneously with the echo sounder, as well as no projecting parts of the hull, discharge and suction openings, etc., which are likely to disturb the normal operation of echo sounders. These requirements are also to be taken into consideration when portable transducers are provided.

3.4.4 Transducers are to be installed in special watertight trunks or recesses.

3.4.5 It is allowed to install transducers of echo sounders in cofferdams of cargo tanks on oil tankers or in way of fuel oil tanks on all ships, provided they are situated in a special gasproof recess which is an integral part of the hull structure.

3.4.6 Transducers are to be so installed that their emitting and receiving surfaces are parallel to the horizontal plane and at one level when the ship is on even keel and is not inclined. This requirement also applies to portable transducers. The deviation from the horizontal plane of not more than ± 3° is allowed.

3.4.7 The transducers installed in bottom slots are to be so arranged that their emitting surface is on one level with the shell plating of the ship's hull. In case of excessive curvature of the ship's hull, projecting parts of transducers are to be protected by steam-liners arranged in bow-stern direction.

3.4.8 Additional strengthening measures are to be applied, where necessary, to increase the rigidity of the shell plating when transducers are installed in bottom slot.

3.4.9 The emitting surface of transducers is not to be painted.

3.4.10 Free access to cable boxes and transducers is to be provided from the inside of the ship.

3.4.11 To avoid electromagnetic interference the line transducer – receiver – amplifier is to be remote from the line transducer – emitter at a distance of not less than 1 m, and from other electrical equipment and parallel cables of not less than 0,5 m. Both lines are to be adequately screened. The feeding cables leading to transducers in spaces below the bulkhead deck are to be mounted in gasproof steel pipes.

3.4.12 The impulser generator is to be installed in a special dry compartment protected from harmful exposure of the environment, and is to be accessible for using. Installation of high voltage units and joint boxes in holds intended for dangerous goods carriage is not allowed.

3.5 RADAR

3.5.1 The radar aerial is to be installed so as to provide all round scanning of the horizon and to prevent the shipboard radar display unit from hindering by superstructures (funnels, top searchlights, lanterns, masts, etc.).

The radar aerial is to be installed above or below the transverse structural elements producing interferences. When the aerial is installed below a transverse structural element, the angle between them in the vertical plane is to be no less than 5°.

3.5.2 The aerial of the radar is to be installed at a height sufficient to prevent the flux density of the power of high frequency emissions from reaching the level in excess of the rate value permissible for the ship's open decks likely to be visited by any person on board the ship.

Every possibility is to be provided for inspection and repair of any part of the aerial in all cases.

3.5.3 On ships operating in navigation areas having constructions which may restrict fairways in height (bridges, etc.) a possibility is to be provided of easy and prompt lowering the aerial by one crewmember. The aerial is recommended to function in lowered position in compliance with the requirements of 3.5.1. In case of remote controlled aerials an emergency manual lowering is to be provided.

Height of structural aerial components in the lowered condition is not to exceed the overall depth of the ship together with its stationary constructions. The lowering of the aerial is not to cause disconnection of feeder line.

3.5.4 Installation of the radar aerial near funnels is not allowed.

3.5.5 The aerial is to be erected, as far as possible, above the transmitter. If the laying of the straight waveguide is impracticable, the number of bends is to be reduced to a minimum.

3.5.6 All guys of the mast on which the aerial of the radar is erected are to be broken up with rigging insulators into unequal lengths of 2 to 6 m each. If such insulation of guys is impracticable, they are to be electrically connected to the ship's hull.

3.5.7 In pushers, push-tugs, cargo push-ships the shipboard main radar display unit is to be installed in the control station, close to the fore bulkhead, so that the operator may easily observe the radar screen display from the workstation with his sight axis minor changing.

Other ships are recommended to meet this requirement as well.

If there is an additional radar display unit, it is to be located in close vicinity of the ship's control and manoeuvring station.

3.5.8 If the ship is provided with two separate radars, in their simultaneous operation the one located in accordance with 3.5.7 is to be considered as the main display unit.

3.5.9 It is allowed to install the radar transmitter and receiver on the front or side wall of the wheelhouse, in the place protected from water penetration.

3.5.10 It is allowed to install the radar supply and voltage control unit in the wheelhouse, provided the mechanical noise level and the level of electrical interference to radio reception caused by this equipment do not exceed the permissible rates. Otherwise, the above-mentioned equipment is to be installed in a special enclosed and well-screened compartment.

3.5.11 In case the switches are located not on the display unit but separately, this separate unit is to be installed in close vicinity of the display unit.

3.5.12 The all round scanning diagram indicating the shadowed sectors is to be posted up at the installation site of the radar display unit.

3.6 RATE-OF-TURN INDICATOR

3.6.1 The rate-of-turn indicator is to be located ahead of the helmsman and within his field of vision.

3.7 COMBINED SHIP'S CONTROL DESK

3.7.1 The combined ship control desk is to be arranged in the ship's control station.

3.7.2 Depending on the design of the combined ship's control desk adopted in compliance with the requirements of 4.7.4, it is to be arranged in the wheelhouse symmetrically to the centre line, or parts or sections of the desk may be installed to the right or to the left from the centre line, provided the requirements of 4.7.13 are met.

3.7.3 One of the steering gear remote controls is to be arranged in the centre line. Course and rudder blade indicators are to be so located that the possibility is provided for taking readings from any point of the wheelhouse.

3.8 INTEGRATED NAVIGATIONAL SYSTEM

3.8.1 Control panels of the navigational devices forming a part of the integrated navigational system, display units and input-output devices may be arranged in separate sections of the navigational desk.

3.8.2 Integrated navigational system is to be installed in the control station or in the chartroom so that the operator can use the navigational equipment and keep a proper look-out.

3.8.3 Separate items of navigational equipment forming a part of the integrated navigational system which do not require constant observation and operational control may be installed in the equipment room or in specially enclosed compartment of the control station.

3.9 UNIFIED TIMING SYSTEM

3.9.1 The unified timing system station is to be installed in the control station in such a location as to provide its easy maintenance.

3.9.2 The controllable clock with the digital read-out provided for the service rooms is to be located in the control station and in the main machinery control room, if any.

3.10 ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM

3.10.1 The electronic chart display and information system (ECDIS) is to be installed in the control station so as to provide the convenient use of the system display and controls, radar and ARPA displays and environment observation.

3.11 HEADING CONTROL SYSTEM

3.11.1 The system control panel of the regular manual steering system is to be connected with the manual control panel by a mechanical or electrical transmission and is to be installed next to it.

3.11.2 The combined manual and automatic control desk is to be installed in the control station in the centre line of the ship so as to provide easy maintenance and quick switching from automatic to manual control or vice versa.

3.11.3 The remote control panels of the system are to be installed on the bridge wings or in places convenient for their use.

3.12 OTHER NAVIGATIONAL EQUIPMENT

3.12.1 The navigational equipment specified in Table 2.1.2, items 5 to 11, is to be arranged and kept in the places of its usage, provided the following requirements are met:

.1 deck watch is to be located in the control station, in the most convenient place for observation;

.2 anemometer is to be installed on the navigating bridge in the place exposed to winds, and in case of crane ships it is to be installed in the place specified by the ship's safe operation conditions;

.3 binocular is to be kept in a specially provided box in the control station;

.4 staff gauge is to be kept in the ship's fore end, on the deck in way of the bulwark and, if necessary, be secured in such a way as to enable its easy use;

.5 inclinometer is to be installed in the ship's control station perpendicular to the ship's centre line;

.6 the thermometer is to be located at the fore bulkhead edge, outside the wheelhouse so positioned as to be protected from temperature interference, and its graduation divisions be distinctly visible from the control station;

.7 the side searchlights are to be installed on the bulwark of the navigating bridge wings or on the railings of the navigating bridge wings, or on specially provided platforms. In the lowered condition the searchlight, its brackets and its units are not to extend beyond the ship's side. Control panels are to be located in the wheelhouse or on the navigating bridge wings.

The top searchlight is to be installed on the upper bridge, above the workstation of the watch navigator arranged so high as to provide its all round turning, and hindrance to its light from the ship's constructions is to be reduced to a minimum.

The manual controls of the searchlight is to be so located on the wheelhouse deckhead as to provide easy maintenance, and to enable the watch navigator not to leave his position at the workstation. Where electrically driven, the searchlight controls are to be located on the ship's control panel.

3.13 CABLING

3.13.1 All outer cabling of the shipboard navigational equipment are to be made by means of screened cables and laid in compliance with the requirements of Part IX "Electrical Equipment".

3.13.2 The earthing of the navigational equipment is to be in accordance with the requirements of Part IX "Electrical Equipment".

3.13.3 Insulation resistance of every laid cable disconnected at both ends is to be not less than 20 Mohm, irrespective of the cable length.

4 TECHNICAL AND OPERATIONAL REQUIREMENTS FOR NAVIGATIONAL EQUIPMENT

4.1 GENERAL

4.1.1 Navigational devices and instruments are to be easy for maintenance and safe in operation.

Navigational equipment is to be capable of continuous and consistent functioning under any sea surface state and the ship's movement parameters, under conditions of vibration, humidity and temperature the ship may encounter in service.

4.1.2 All navigational equipment intended for being constantly under twenty-four-hours operating conditions is to be of appropriately protected design and is to operate reliably as specified in 5.1.19, Part XI "Radio Equipment". The working temperature is to be:

.1 from 0 to ± 45 °C for master gyrocompass devices;

.2 from -4 to ± 40 °C for primary speed transducers and echo-sounder transducers in water.

4.1.3 Depending on the location of the navigational devices and instruments on board the ship, the degree of their protection is to be at least:

.1 IP22 – for enclosed dry service spaces;

.2 IP55 – for open decks.

4.1.4 All navigational devices and instruments are to be provided with proper fittings for efficient securing in the regular place.

It is allowed to use the adequate shock absorbing appliance.

4.1.5 Each component of the equipment is to be marked indelibly with the following information:

.1 the manufacturer;

.2 the trade designation of the equipment;

.3 the type of equipment;

.4 the serial number;

.5 the Type Approval Certificate number assigned by the competent authority is to be affixed indelibly to the display unit. The number is to consist of the following symbols e-NN-NNN, where

e = European Union;

NN = code for the country of approval, where:

1 — Germany	18 — Denmark
2 — France	20 — Poland
3 — Italy	21 — Portugal
4 — Netherlands	23 — Greece
5 — Sweden	24 — Ireland
6 — Belgium	26 — Slovenia
7 — Hungary	27 — Slovakia
8 — Czech Republic	29 — Estonia
9 — Spain	32 — Latvia
11 — United Kingdom	36 — Lithuania
12 — Austria	49 — Cyprus
13 — Luxemburg	50 — Malta
17 — Finland	

NNN — three-digit number, to be determined by the Register.

4.1.6 The manufacturer is to issue a Certificate of Conformity for each unit of equipment, accompanied by a manufacturer's declaration to the effect that it meets the prevailing minimum requirements and that it is identical in every respect to the equipment submitted for testing.

4.1.7 Number of controls, their location and method of functioning, place and interlocation as well as their size are to be such as to provide their easy, quick and effective operation. Operative controls which unintended use may result in switching-out, damage or incorrect functioning of equipment are to have the special protection against unauthorized access.

4.1.8 Each complete set of navigational equipment is to be designed for being served by one operator only.

4.1.9 All metallic housings of navigational equipment operating under voltages exceeding standard safety value or producing unallowable electromagnetic radiation are to be provided with special terminals for connecting earthing conductors.

4.1.10 Special design precautions are to be provided to protect the operator against electrical shocks when replacing fuses.

4.1.11 The design and arrangement of plug sockets and other easily removable disconnecting devices are to exclude any possibility of their wrong connections.

4.1.12 All equipment is to be fitted with special devices or interlocks to protect the operating personnel against electrical shock caused by high voltage after opening the housing of a device or instrument for the purpose of inspection, cleaning, repair and replacement of interior parts.

4.1.13 Navigational equipment is to be designed to be supplied from the ship's mains with voltage of no more than 250 V.

4.1.14 The design of all navigational devices and instruments is to insure maintaining their technical parameters when the voltage and frequency of the ship's alternative current mains vary within ± 10 per cent and ± 5 per cent respectively for a prolonged period of time and also when the supply voltage deviates from the rated voltage by + 30 per cent and -10 per cent in the event of power supply from the direct current and also when the supply voltage deviates from the rated voltage by +30 per cent and 25 per cent from the rated voltage in case of power supply from the accumulator battery.

Navigational equipment is to maintain its serviceability under the short-term deviations of the ship's mains voltage within ± 20 per cent during 1,5 s and of the frequency within ± 10 per cent during 5 s. In this case the alarm signalling system is not to start functioning.

The design of navigational equipment is to provide its protection against the accidental polarity reversal of the source of power.

4.1.15 Insulation resistance for separate circuits of devices or instruments is not to be below the values indicated in Table 4.1.15.

Table 4.1.15

Test conditions	Insulation resistance, in Mohm
Normal climatic conditions	20
Temperature 50 ± 2 °C, relative humidity below 20 per cent	5
Temperature 50 ± 2 °C, relative humidity 95 ± 3 per cent	1

4.1.16 All navigational devices and instruments are to be provided with the adequate suppressors capable of preventing the possibility of radio interference voltage at the terminals and housings of such equipment to exceed the level indicated in Table 4.1.16.

Table 4.1.16

Frequency range, in kHz	Radio interference voltage, in mV
10 — 15	63 — 0,3
150 — 350	1 — 0,3
350 — 30	0,3

Electromagnetic compatibility is to be provided in accordance with the requirements of Part IX "Electrical Equipment".

4.1.17 Fitted directly on navigational devices and instruments safety devices or automatic switches are to be provided, these being installed in power supply circuits and designed for the appropriate operational currents and voltages.

It is recommended to fit safety devices and automatic switches in such places where the replacement of fuses or manual handling of automatic switches may be effected by the operator without opening the housing of device or instrument.

4.1.18 Visual indicators of readings and built-in electromagnetic instruments of permanent operational use are to be mounted on the front panel of the navigational device or instrument.

The instrument controls are to be mounted on the front panel or in some other readily accessible place.

The equipment is to be designed in such a way that operating mistakes in manipulation of the controls cannot cause its failure.

4.1.19 Controls and monitoring devices are to be provided with distinct inscriptions and/or generally accepted designations and markings showing their purpose and operation. All numerals and letters on marine navigational radar equipment are to be at least 4 mm high. If for technical reasons numerals and letters 4 mm high are not possible and if for the purposes of operation smaller letters are acceptable, a reduction to 3 mm is to be allowed.

4.1.20 Controls and means of adjustment which are not used in every day operation of the device or instrument may be mounted inside the housing, and/or they are to have spline adjustment.

4.1.21 Navigational devices and instruments are to be provided with proper lighting of front panels on which controls and means of adjustment are mounted; in this case the requirements of 4.1.29 are to be met.

4.1.22 If the electron-ray or liquid crystal indicator is provided in the navigational equipment, measures are to be taken to keep the indication under observation in the day time and at night.

4.1.23 The design of navigational devices and instruments is to prevent controls from heating by interior heat radiation to temperature exceeding the value specified in 15.1.5, Part IX "Electrical Equipment".

4.1.24 The diagram and design of navigational devices and instruments are to preclude any possibility of damage as a result of wrong sequence in manipulating controls.

4.1.25 All navigational devices and instruments are to be provided with proper visual signalling system to indicate their "on" position.

It is also recommended to provide a visual signalling system to indicate high-voltage "on" position and the switching of essential modes of operation.

4.1.26 Navigational devices and instruments are to be provided with audible and/or visual signalling system capable of indicating any fault in the equipment operation.

It is recommended that such a signalling system is automatically switched on when critical load level in the equipment operation is likely to lead to its being put out of action.

The level of sound pressure caused by an alarm is to be not less than 75 dB(A) but not more than 85 dB(A) at a distance of 1 m from an emission source.

The types of signalling systems and faults or critical load levels, for which the signalling systems are intended, are, in each case, subject to special consideration by the Register.

4.1.27 Signal lamps and other means of visual control are to be fitted in the devices, instruments or control panels and are to be clearly visible to the operator in diffused daylight.

4.1.28 The colours of signal lamps used for each particular kind of signalling system are to comply with the requirements of Part IX "Electrical Equipment".

4.1.29 Lighting intensity of the signal, indicator and lighting lamps of devices and instruments installed in the wheelhouse is not to interfere with the normal work of the helmsman and the navigator.

The lighting intensity is to be regulated.

4.1.30 For manufacture of navigational devices and instruments the materials are to be used according to 2.3, Part IX "Electrical Equipment".

4.1.31 Navigational instruments are to be capable of interfacing to other radio and navigational equipment and also to an integrated navigation system.

Formats used for numerical information exchange are to be in compliance with International Standard on Interface of Marine Radio and Navigational Equipment.

4.1.32 Navigational equipment is not to fail when electrostatic discharges onboard the ship act on its external surfaces (6 kV when contacted and 8 kV for a space discharge).

4.1.33 The level of acoustic noise caused by navigational equipment is not to exceed 60 dB at a distance of 1 m from any equipment component.

4.1.34 Navigational devices with several modes of operation are to have an indication of a mode in use.

4.1.35 The operative software of navigational equipment is to be protected against an unintended access. If malfunctions arise, an automatic functioning control of software and alarm is to be provided.

4.1.36 The maintenance documentation information is to be sufficient for the proper use of navigational equipment by the ship's personnel.

Navigational equipment designed so that malfunctions diagnostics and the following repair are possible up to the circuitry, is to have a set of electric circuits and wiring diagrams and also equipment components specification.

Maintenance documentation for navigational equipment consisting of separate modules, the repair of which on board the ship is not provided, is to include a procedure for detection and replacement of a failed module.

4.1.37 A detailed Operating Manual and a summarized Operating Manual (in a durable form) is to be supplied with each unit. Both manuals are to be available in Dutch, English, French and German.

4.2 MAGNETIC COMPASS

4.2.1 Magnetic compass is to be capable of indicating the ship's course with the following accuracy:

$\pm 1°$ — ship under way, no rolling;

$\pm 5°$ — ship under way, rolling in all directions up to $\pm 15°$ with a period of 7 s.

4.2.2 The compass card of the standard and steering magnetic compasses is to be capable of indicating the reading with accuracy of 0,5°. Graduation division of the compass is not to exceed 1°.

4.2.3 With the horizontal component of magnetic field H (μ T) at the point of compass installation and the temperature of the ambient air $+20 \pm 3$ °C, the magnetic compass card stagnation is not to exceed $(3/H)°$ after deflecting the compass card from the magnetic meridian by ± 2°.

4.2.4 Magnetic compass is to be provided with an effective damping device capable of ensuring the compass card stability under the ship's vibrations and with a device ensuring normal position of the compass bowl vertical axis under the ship's service conditions.

4.2.5 The card is to remain free at the bowl inclination of 10° in all directions.

4.2.6 Magnetic compasses is to be provided with devices for the compensation of semicircular, intercardinal, inclination and latitude deviation.

Every such device is to be capable of compensating the corresponding deviation with an accuracy up to $\pm 0{,}5°$.

4.2.7 The design of the devices specified in 4.2.6 is to provide the compensation of deviation with values of residual deviation not exceeding $\pm 5°$.

4.2.8 Magnetic compass is to be provided with electric lighting (supplied from main and emergency sources of power) sufficient to make the scale divisions of the compass card distinctly visible. The lighting intensity is to be capable of being regulated. The lighting voltage is not to exceed the safe value.

4.2.9 The extreme height, at which the compass may be installed, is not to exceed the height providing the most convenient operation of the compass, including bearings.

4.2.10 It is recommended to fit the compasses with bearing finders capable of taking bearing of all visible objects and heavenly bodies with reading accuracy of $\pm 0,5°$.

4.2.11 The steering compass card is to be capable of ensuring accurate indication of readings at a distance of not less than 1,4 m both at day and artificial lighting. The use of magnifying devices is allowed.

4.2.12 Magnetic compass with electric remote transmission of dial readings is to comply with the requirements of 4.2.1 to 4.2.10. Besides, they are to be capable of indicating the ship's course on the repeaters.

4.2.13 Magnetic system of the standard magnetic compass or special magnetic sensitive elements may be used to serve as a sensitive element of the magnetic compass with electric remote transmission of dial readings.

4.2.14 Where the magnetic system of the standard magnetic compass is used for remote transmission of readings, the device intended for electric transmission of readings to repeaters is to be so designed as to provide that its arrangement and operation will in no way affect taking bearings, indication of course and bearing of the compass card as well as the work for compensation of deviation.

4.2.15 A special sensitive element is to include a device for compensation of deviation in compliance with the requirements of 4.2.6 and 4.2.7.

4.2.16 The sensitive element impulser and the whole electric remote transmission system of the magnetic compass dial readings are to remain capable of normally operating under the following variations of the ship's movement:

.1 circulation with angular speed up to 6°/s;

.2 yawing with period 10 to 20 s and the maximum course deviation $\pm 5°$.

4.2.17 Divergence between the readings of repeaters and those of the sensitive element of the magnetic compass fitted with remote transmission of dial readings is not to exceed 1°.

4.2.18 The accuracy of readings of the standard compass and the operating repeaters is not to be affected by failure or switching-off of separate repeaters.

4.2.19 Audible signalling system is to be provided to indicate any failure in the follow-up system of the magnetic compass fitted with electric remote transmission of dial readings. The audible signalling system is to be supplied with power from an independent source of power.

4.2.20 A special lighted panel "Repeaters are switched to magnetic compass" is to be included into a complete set of the magnetic compass fitted with remote electric transmission of readings (refer to 3.2.2).

4.2.21 The design of the magnetic compass fitted with optical remote transmission of dial readings is to provide the screen to present the direct reflected image of the card dial sector with clearly visible divisions of degrees on the arc of not less than 30° as well as the lubber's line fitted in the casing of the compass bowl.

It is recommended to provide a device capable of presenting the card dial image from fore and aft sides of the periscope.

4.2.22 The length of the projection tube periscope of the magnetic compass fitted with optical remote transmission of dial readings is to ensure the possibility of fitting the screen at eye-level of the helmsman.

The height of the screen is to be capable of being regulated by 100 to 150 mm up and down from the mean position.

4.2.23 The screen is to be provided with a device protecting it from bright sunshine or other source of light capable of distorting the image on the compass card screen by floodlighting. The image is to be distinctly visible on the screen in the day time and at night.

4.2.24 The design of the optical system is to ensure distinct and clear image of the dial sector both during visual bearing taking and with the compass cap closed.

4.2.25 A suitable device for adjusting and fixing of the screen position to facilitate read-out is to be provided.

4.2.26 The enclosure of the optical system is to be of waterproof IP56 design. The adequate measures are to be taken to prevent sweating and condensation of moisture in the enclosure. The easy access is to be provided to optics for the purpose of cleaning.

4.3 GYROCOMPASS

4.3.1 The gyrocompass positioned on a horizontal and stationary base in latitudes of up to 60° is to meet the following requirements:

.1 the gyrocompass is to be brought into alignment with meridian within 6 h;

.2 the steady state error at any course is not to exceed $\pm 0,75° \times$ secant latitude and the root mean square value of differences between individual course indications and the mean is to be less than $0,25° \times$ secant latitude;

.3 the permissible error from one run-up to another is to be within $0,25 \times$ secant latitude;

.4 follow-up system performance speed is to be not less than 6°/s.

4.3.2 The gyrocompass mounted on board the ship under operational conditions in latitudes up to 60° is to meet the following requirements:

.1 under rolling and pitching harmonic motions of up to 5° with a period of 6 to 15 s at maximum acceleration of 0,22 m/s^2 the gyrocompass is to be brought into alignment with meridian within 6 h;

.2 the error of the master compass readings under service conditions, due to variations in the ship's power supply and possible alterations of magnetic fields is not to exceed $\pm 1° \times$ secant latitude;

.3 the error of readings due to a rapid alteration of the ship's speed of 20 knots is not to exceed $\pm 2°$;

.4 the error of readings due to a rapid alteration of course of 180° at a speed up to 20 knots is not to exceed $\pm 3°$;

.5 the residual error at a straight course (after correction for speed and course and, if necessary, latitude influences) at a steady speed of up to 20 knots is not to exceed $\pm 0{,}25° \times$ secant latitude;

.6 errors of readings due to rolling up to 20°, pitching up to 10° and yawing up to 5° with a period of 6 to 15 s and the maximum horizontal accelerations not more than 1 m/s^2 are not to exceed $1° \times$ secant latitude;

.7 the divergence in readings between the master compass and repeaters is not to exceed $\pm 0{,}5°$.

N o t e . The errors specified in 4.3.2.3 to 4.3.2.6 are taken to be the difference between the observed and the settled point heading values.

4.3.3 The complete set of gyrocompass is to be provided with a corrector used for correction of compass readings in respect to the ship's speed and latitude. It is also recommended to provide a course recording device (a course recorder) in the set of gyrocompass.

4.3.4 A course recorder is to be capable of recording the ship's course in respect of time with an accuracy of ± 1 per cent.

4.3.5 The system of gyrocompass readings remote transfer is to be so designed as to ensure simultaneous operation of gyrocompass repeaters, of a course recorder, and also of repeaters fitted in other navigational equipment.

4.3.6 The design of repeater cards, bearing taking devices, lighting fittings and other arrangements is to be capable of ensuring the indication of course and bearing readings in compliance with the requirements of 4.2.2, 4.2.4, 4.2.8 (except for the requirements as regards the reserve self-contained source of lighting, kind of electric current and voltage), 4.2.9 and 4.2.10.

4.4 ECHO SOUNDERS

4.4.1 Echo sounders are to be capable of:

.1 measuring any clearance under the transducer between 0,2 m to 40 m;

.2 accuracy of measuring any clearance not less than ± 10 sm with depths of up to 3,5 m;

± 3 per cent of the immediate depth over 3,5 m;

.3 presentation of readings on the whole designed depth range.

4.4.2 The echo sounder is to meet the following requirements:

.1 the depth range is to be divided, at least, into two bands: shallow depth band covering the depth from 0 up to 10 m and deep depth band covering the depth from 0 up to not less than 40 m;

.2 the echo sounder is to be provided with the manual adjustment of intensifying the pulse repetition rate;

.3 depth indicator scales are to ensure shallow band readings with the accuracy of not less than 0,1 m.

4.4.3 The echo-sounder performance is not to deteriorate when the ship is rolling $\pm 10°$ and pitching $\pm 5°$.

Some omissions in readings are permissible when the ship is rolling more than $\pm 10°$ and/or pitching more than 5°, the sea bed has rocky or steeply sloping character (over 15°).

4.4.4 The complete set of the echo sounder is to include one or more transducers, the main unit with built-in depth indicator, and also the translating device for data transmitting to other ship's systems. The complete set of the echo sounder may also include a recorder and remote repeaters.

The echo sounder design is to provide a possibility of displaying the immediate depth on the depth indicator and of recording it on the recorder.

The recorder may be built into the echo sounder main unit.

4.4.5 More than one transducer including portable fitted in different parts of the ship may be used in the echo sounder composition. In doing so, a clear indication of the transducer used is to be provided.

4.4.6 The echo sounder design is to simultaneously provide the presentation of depth information in the digital form displaying the immediate depth with the accuracy of readings not less than 0,1 m.

Simultaneously depth information may be presented in the graphical form. In this case a visible record of soundings is to be provided during at least 15 min.

4.4.7 The echo sounder is to be provided with audible and visual alarm signals of the ship's approach to the preset depth.

4.4.8 The echo sounder is to be provided with a device to allow a correction for determination of a depth under the most immersed part of the ship.

4.4.9 It is recommended to provide the echo sounder with audible and visual alarms to indicate failures, affecting the reliability of information displayed, and also the interruption of power supply and the critical change of the ship's mains parameters specified in 4.1.14.

4.4.10 The echo sounder recorder is to provide the recording of information about depth with time marks during the previous 12 h. Moreover the shore-based retrieval of recorded information is to be provided.

4.4.11 Recording of the echo sounder indications may be carried out on the paper tape or other media.

If paper tape is used, the relevant marks are to be provided on its right side indicating when the paper remaining is less than 1 m.

4.4.12 Switching on of the echo sounder is to be effected by one manipulation.

The starting period is not to exceed 30 s.

4.5 RADAR

4.5.1 The radar equipment is to provide detection and clear indication of overwater and onshore objects (natural and artificial objects, navigation marks) as well as their positioning by means of continuous uninterrupted all round scanning of the horizon under relative motion presentation.

The display of all objects is to remain visible when the ship is at heel of ±15°.

4.5.2 Basic performance parameters of the shipboard radar, with the aerial height above the water level being equal to 7 m are not to be worse than those specified in Table 4.5.2.

Table 4.5.2

Nos	Basic performance parameters	Value
1	Minimum radar detection range (dead zone radius), m	15
2	Minimum range of operation, m	1200
3	Range resolution, m	15
4	Width of directional diagram in vertical plane above horizontal plane, at least, at 3 dB level, deg.	≤ 10
5	Angle resolution, deg.	1,5
6	Accuracy in range measuring in relation to the indicated range of operation, %:	
	fixed range ring	±1 (⩽10 m)
	variable range ring	±2,5(⩽15 m)
7	Accuracy in angle measuring , deg.	±1
8	Accuracy in course indication, deg.	±0,5
Note. The above stated values are related to the standard radar reflector with echoing area of 10 m^2.		

4.5.3 The display unit of the radar station is to be capable of providing the possibility for image orientation in relation to the fore-and-aft line of the ship.

4.5.4 It is to be possible for a single person to operate the radar equipment and watch the display simultaneously.

If the control panel is a separate unit, it is to contain all controls used directly for radar navigation.

Cordless controls are not to be permitted.

4.5.5 Controls are to be as few as practicable. The controls are to be easy to operate, clearly designated and identified at night.

Functions that can cause a deterioration of resolution are not to be switchable in range scales up to 2000 m.

The system sensitivity is to be such that a standard reflector at a distance of 1200 m appears clearly on the radar picture on every revolution of the antenna. In the case of a 1 m^2 reflector at the same distance, the quotient of the number of antenna revolutions with radar echo during a specific period and the total number of antenna revolutions in that same period based on 100 revolutions (blip-scan rate) is not to be less than 0,8.

4.5.6 The radar is to be ready for operation within 4 min of being switched on.

4.5.7 The display unit is to be provided with a tuning indicator. The tuning scale is to have a length of at least 30 mm. The indicator is to function in all ranges, even without radar echoes. The indicator is to function equally well when the gain or suppression of close proximity echoes is activated.

A manual control to correct the tuning is to be available.

4.5.8 The range of the gain control is to be such that, at minimum sea-clutter suppression setting, surface movement of the water is clearly visible and that powerful radar echoes with an echo area equivalent to 10 000 m^2 may be cut out at any distance.

4.5.9 Frequency of presentations change depending on the ship's speed is to be in conformity with the requirements specified in Table 4.5.9.

Table 4.5.9

Ship's speed, in km/h	Number of aerial rotations, in rotation/min	Frequency of repeated presentations, in Hz	Time of repeated presentations
0 — 30	21 — 39	0,35 — 0,65	3 — 1,5
over 30	⩾ 60	⩾1	⩽ 1

4.5.10 Previous positions of targets are to be shown by means of a trail.

The representation of the target trail is not to last longer than 2 antenna revolutions and the brightness is not to be less than that of the associated target.

The colour of the target trail is to be the same as the colour of the associated target.

The persistence of the trail is to be adjustable to operational requirements.

The target trail is not to impair the radar picture.

4.5.11 The radar display is to have an effective diameter of at least 270 mm (12 inches).

4.5.12 The radar is to have the following range scales switched on successively provided with the appropriate fixed range rings:

range 1 — up to 500 m — one ring every 100 m;
range 2 — up to 800 m — one ring every 200 m;
range 3 — up to 1200 m — one ring every 200 m;
range 4 — up to 1600 m — one ring every 400 m;
range 5 — up to 2000 m — one ring every 400 m.

Successive switching on of additional scale ranges is allowed.

The selected range scale, the distance between range circles and the distance of the variable range marker are to be indicated in metres and kilometres.

The width of the range circles and the variable range marker are, at the normal brightness setting, not to exceed 2 mm.

4.5.13 Fixed range rings and variable range rings are to enable the range of a detected object to be measured.

The intervals between fixed range rings are to be linear and designated in meters or kilometers only.

Within one range at least two fixed range rings and not more than six fixed range rings are to be provided.

The variable range ring is to provide continuous measurement of distances in all the available ranges. Within eight seconds, it is to be possible to set the range marker to any distance. The distance at which the variable range marker is set is not to change even after switchover to other range scales. The range is to be displayed as a three- or four-digit number. The accuracy for ranges up to 2000 m is to be within 10 m. The radius of the range marker is to correspond to the digital display.

4.5.14 To permit an extended forward view, off-centring of the radar picture is to be possible at all range scales. Off-centring is to result exclusively in an extension of the forward view and is to be adjustable to at least 0,25, and at most 0,33, of the effective screen diameter.

In the range with extended forward view, the range circles are to be extended and the variable range marker is to be adjustable and readable up to the maximum of the displayed range.

A fixed forward extension of the range displayed is permitted provided that the bearing scale is designed in such a way that a bearing can be taken.

Neither separate sectors, nor their enlarged representations are to be displayed.

4.5.15 A lubber line is to extend from the position on the radar display that corresponds to the antenna position up to the edge of the radar screen.

The width of the lubber line at the edge of the screen is not to be more than 0,5°.The radar unit is to have an adjusting device for correcting any azimuthal angular error in the antenna mounting.

Following correction of the angular error and activation of the radar unit, the deviation of the lubber line from the keel line is not to exceed 0,5°.

4.5.16 The radar equipment is to have a bearing scale at the edge of the screen.

The bearing scale is to be divided into at least 72 parts each representing 5 degrees. The graduation marks representing 10 degrees are to be clearly longer than those representing 5 degrees.

The 000 mark on the bearing scale is to be positioned in the middle of the upper edge of the screen.

The bearing scale is to be marked in three-figure numbers from 000 to 360 degrees in a clockwise direction. Numbering is to be in Arabic numerals every 10 or every 30 degrees.

The figure 000 may be replaced by a clearly visible arrow.

Facilities for taking bearings of targets are to be allowed.

If such facilities are provided, they are to be capable of taking a bearing of any target within approximately 5 s, with maximum error of ±1 degree.

If an electronic bearing line is used, it is to:

be clearly distinguishable from the lubber line;

be displayed quasi-continuously;

be freely rotatable through 360 degrees left and right;

be at most 0,5 degrees wide at the edge of the screen;

extend from origin up to the bearing scale;

and complete a three- or four-figure decimal degree reading.

If a mechanical bearing line is used, it is to:

be freely rotatable through 360 degrees left and right;

extend from the marked origin to the bearing scale;

bear no further markings; and

be designed in such a way that echo readings are not obscured unnecessarily.

4.5.17 The radar equipment is to have facilities with manual controls for reducing clutter from sea and rain.

The sea-clutter control, at its maximum setting, is to be effective up to a distance of approximately 1200 m.

The radar equipment is not to be provided with automatic facilities for reducing sea and rain clutter.

There is to be a switchable facility for the reduction of interference caused by other radar equipment. The operation of his facility is not to suppress the display of useful targets.

4.5.18 Radar emission frequency is to be 9 GHz. Signals from radar beacons are to be displayed clearly with the rain clutter suppression switched off.

The frequency of 9 GHz is preferable as it is coincident with that of responders.

The maximum value of harmful collateral emission (clutter due to harmonic oscillations) is not to exceed 1×10^{-2} W.

The transmitter's side lobes emission and the receiver's collateral emission are not to exceed 1×10^{-9} W.

4.5.19 Only the lubber line, bearing lines and range circles may be superimposed on the radar screen.

Apart from the radar picture and in addition to information on the operation of the radar equipment, only nautical information such as that listed below may be displayed:

rate of turn;

speed of the ship;

rudder position;

water depth;

compass course.

All screen information besides the radar picture is to be displayed quasi-statically and the refreshing rate is to satisfy the operational requirements.

The requirements regarding the display and accuracy of nautical information are to be the same as those applicable to the main equipment.

4.5.20 The display is to have an efficient device for regulation of brightness.

4.5.21 To facilitate observation both in the daytime and at night, appropriate vision aids (light shield or another facility) are to be available. If necessary, provision may be made for prompt change of presentation colours and display brightness.

Vision aids are to be usable by wearers of spectacles.

4.5.22 Slave indicators are to comply with all requirements applicable to navigational radar equipment.

4.6 RATE-OF-TURN INDICATOR

4.6.1 The device is to indicate the direction and angular speed of the ship's turn designated in deg./min.

4.6.2 The rate-of-turn indicator is not to cause spontaneous rudder shifting. If a rate-of-turn regulator is used, provision is to be made for its switching off at any given position without changing the chosen speed.

4.6.3 The device controls are to be arranged on the main rate-of-turn indicator display.

4.6.4 The rate-of-turn indicator is to be ready for operation within 4 min of being switched on.

4.6.5 The rate-of-turn indicator is to have visual alarm and built-in measuring instruments enabling to ascertain its switch-on and operation within permissible deflections. Where, in addition to the rate-of-turn regulator, there are other steering systems, it is to be possible to clearly distinguish at the steering position which of these systems has been activated. It is to be possible to shift from one system to another immediately.

4.6.6 Display measuring scales are to be fitted with adjustable lighting.

4.6.7 The rate-of-turn indicator may be in service as an independent instrument, or be a part of any relevant equipment or be provided with information therefrom.

4.6.8 In accordance with measurement ranges the ship's rate-of-turn indicators are to be subdivided into the following types:

A (measurement range 90 — 0 — 9 deg./min);

B (measurement range 180 — 0 — 180 deg./min);

C (measurement range 300 — 0 — 300 deg./min).

4.6.9 In tugs and pushers indicators of A and B types or indicators of combined types are to be installed. Other self-propelled ships are to be fitted with indicators of B type. Installation of C type indicators is recommended for hydrofoils, air cushion vehicles and planing boats.

4.6.10 The sensitivity and accuracy of the above stated indicators is to comply with the following requirements:

A type – sensitivity 2 per cent of the maximum limit, accuracy ± 5 per cent of measured rate of turn;

B and C types – sensitivity 2 per cent of the maximum limit, accuracy ± 10 per cent of measured rate of turn.

Combined type indicators are to be characterized by the similar sensibility and accuracy.

4.6.11 Additionally the following measurement ranges may be provided:

30 — 0 — 30 deg./min;

60 — 0 — 60 deg./min.

4.7 COMBINED SHIP'S CONTROL DESKS

4.7.1 Controls and indicating instruments of navigational equipment and of other gears for the ship's handling required by the present Part or other parts of the Rules and intended for installation in a place from which the ship is operated may be arranged in the combined ship's control desks.

4.7.2 Controls and indicating instruments mentioned in 4.7.1 are controls and instruments intended for:

.1 changing the ship's movement (remote control of main engines, blades of controllable pitch propellers, propeller shaft tachometers, pitch indicators of the CPP, etc.);

.2 communicating orders and recording commands on changes on the ship's movement by electromechanical means (engine telegraphs, reverse recorders, etc.);

.3 observing navigational features in the area concerned (radar displays, depth indicators, anchor cable indicators, etc.);

.4 indicating the values relating to the ship's movement (course, speed, distance, helm, rate of turn, draught indicators, etc.);

.5 controlling very high frequency radio communication means (remote controls and voice communicating devices);

.6 external audible and visual signalling (manual controls for whistles, timing units for automatic generation of audible and visual signals, remote controls of electric megaphones, masthead flashing light and day signalling lamps keying devices, navigation lanterns communicators, etc.);

.7 internal communication and audible signalling (telephones of two-way communication, communicators of public address system, telephones of the ship's automatic exchange, alarm signalling switches, etc.);

.8 ensuring survivability of the ship and other essential operations (watertight and fire doors closing, starting of fire-fighting systems, control of anchor arrangement, ventilation of accommodation and service spaces and holds, thruster and active rudder, etc.);

.9 audible and visual signalling to indicate any failure and executive signalling to indicate the given command fulfilment (general and individual signalling on failures of essential machinery, systems and gears, signalling on limit values of various parameters, for example, temperature, pressure, revolutions, depths, etc.);

.10 automated and automatic control of the ship and for making decisions on passing and preventing collisions of ships at sea;

.11 distribution, switchgear and protection devices provided in Part IX "Electrical Equipment".

4.7.3 Provision is to be made in the design of the combined ship's control desk for the appropriate panels for free and convenient arrangement of the necessary controls and indicating instruments, and its inner spaces are to be sufficient for arrangement of inner wiring and devices in accordance with 4.7.2.11, if any.

4.7.4 The combined ship's control desk may be designed both as one common unit and as separate sections, mechanically and electrically connected with one another, indicating instruments may also be fitted in separately standing desks.

4.7.5 The dimensions of the combined ship's control desk are to be such as to provide the fulfilment of the requirements of 4.7.3 with respect to the devices and instruments built into the desk, as well as the possibility of using controls and observing the instruments, controls and signalling means installed therein when the operator stands facing the ship's bow and to prevent interference for look-outs.

4.7.6 The requirements of 4.7.5 are to be considered fulfilled if the depth of separate sections of the whole desks fitted at the fore bulkhead of the wheelhouse ensures the access to the scuttles and does not exceed 650 mm.

4.7.7 The panels of the combined ship's control desk may be inclined at any angle ensuring the most exact taking of readings from the indicating instruments and convenient use of controls.

4.7.8 All the controls are to be so installed as to be easily accessible for the personnel and close to the indicators and instruments related thereto or made integral with the latter within the boundaries clearly indicated on the panel. They are to have distinct markings showing the purpose and the direction of the control operation.

4.7.9 Indicating devices installed on the combined ship's control desk are to provide continuous and automatic information.

The use of indicating devices giving the information only on call of the operator is allowed.

4.7.10 Where the audible and visual signalling systems capable of indicating any fault in the operation of instruments and machinery are provided, the audible and visible signals are to be clearly heard and distinctive. Intermittent audible alarm and signals of various tones are to be used where necessary.

Controls of emergency systems installed in the desk are to be red. The corresponding portions of scales of instruments intended for indicating emergency and pre-emergency conditions in the systems are to be painted red. In this case:

.1 confirmative signals of starting machinery, systems and arrangements are to function not from the movement or position of controls, but from pulses directly characterizing the working condition of the item of machinery, system or arrangement concerned;

.2 depending on the meaning of light signals, the colours are to be used in accordance with the requirements of 4.1.28.

4.7.11 Controls arranged in compliance with 4.7.8 are to be so designed that the direction of movement of steering wheel, handle, lever, switch, etc. may correspond to the change of the parameter to be controlled as it is specified in 4.11.18, in Part VI "Machinery Installations" and in Part IX "Electrical Equipment".

4.7.12 Controls and devices built in the combined ship's control desk are to be fed in compliance with the requirements of the present Part or from the distribution gear put in the combined ship's control desk and meeting the requirements of Part IX "Electrical Equipment".

4.7.13 The combined ship's control desk is to be so designed or its separate sections are to be so assembled that controls and indicating instruments vital for the safety of the ship's navigation and intended for immediate use under extraordinary circumstances when the ship is under way be arranged in the desk to the right from the centre line. This condition will be fulfilled if the controls and indicating instruments listed in 4.7.2.1 to 4.7.2.6 are placed from the starboard to the centre line, in ascending order.

Controls and indicating instruments listed in 4.7.2.7 to 4.7.2.9 as well as in 4.7.2.10 may be arranged to the left from the centre line.

4.8 INTEGRATED NAVIGATIONAL SYSTEM

4.8.1 The integrated navigational system is to combine individual navigational devices and equipment to monitor navigational environment and provide the appropriate alarms.

According to the extent of functions performed, integrated navigational systems are to be subdivided into three categories:

Category A – systems providing processing and displaying data on the ship's heading, speed and position, and also on a current time;

Category B – systems providing automatic processing and displaying data on the ship's heading, speed, current position, and also on a depth, and a generation of warning about hazards known and detected along the pre-planned route;

Category C – systems providing, in addition to the category B functions, automatic control of the ship as to a heading, track or speed, and carrying out control parameters monitoring.

4.8.2 The integrated navigational system is not to impair characteristics of navigational devices and equipment being part of it.

4.8.3 In case of failure of data processing individual units, the serviceability of all navigational devices and equipment, being part of an integrated navigational system, is to be ensured.

4.8.4 A malfunction or failure of any navigational device or equipment, being part of an integrated navigational system, is not to affect other parts of the system except for those serviceability of which directly depend upon the failed part.

A restoration of an integrated navigational system functioning after its failure is to be possible only after an advance notice of an operator and his confirmation that a system is ready for working.

4.8.5 The navigation information from the navigational sensors is to be interfaced with the system automatically. Manual input of some data may be provided if a sensor fails.

4.8.6 An integrated navigational system is to make available for an operator the necessary navigational data, and also is to generate warnings in case the sensor data is invalid.

4.8.7 The navigational equipment, being part of an integrated navigational system and ensuring the ship's safe control, is to be duplicated.

4.8.8 An integrated navigational system is to ensure a permanent automatic comparison of the navigational data derived independently from two sensors.

The navigational data displayed and the information used in the automatic control system are to be previously processed in the comparison unit.

It is to be impossible to use invalid data in the automatic control system.

4.8.9 The information necessary for the ship's safe control is to be permanently displayed by an integrated navigational system.

Additional information is to be displayed by a system on the operator's demand.

4.8.10 The control of an integrated navigational system is to be carried out from a common control panel comprising system controls, means of data displaying and alarms actuation.

4.8.11 An integrated navigational system is to ensure protection against the operator's errors during data input.

4.9 UNIFIED TIMING SYSTEM

4.9.1 The unified timing system station is to ensure:

.1 formation and storage of the time scale and its checking against International Accurate Hour's Service signals transmitted through the radio channels;

.2 possibility of centralized shifting of displayed readings of the current time within 0 to 23 h with a step of 1 h;

.3 indication of current time readings transmitted to the controllable clock in hours, minutes, seconds.

4.9.2 The error of the main clock run is not to exceed 0,5 s during twenty-four-hours operation.

4.10 ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM (ECDIS)

4.10.1 ECDIS is to be capable of displaying all information being contained in the system electronic navigational chart (SENC).

4.10.2 SENC information intended for route planning and route monitoring is to be subdivided into three categories: display base, standard display and supplementary information.

4.10.2.1 Display base chart information consists of:

.1 coastline (high water);

.2 own ship's safety contour (to be selected by the operator);

.3 indication of isolated underwater dangers or depths less than the safety contour which lie within the safe waters defined by the safety contour;

.4 indication of isolated dangers which lie within the safe water defined by the safety contour (bridges, overhead wires, etc., including buoys and beacons whether or not these are being used as aids to navigation);

.5 traffic routeing systems;

.6 scale, range (in miles), orientation and display mode;

.7 units of depth and height.

4.10.2.2 Standard display chart information consists of:

.1 display base;

.2 drying line;

.3 indication of fixed and floating aids to navigation;

.4 boundaries of fairways, channels, etc.;

.5 visual and radar conspicuous features;

.6 prohibited and restricted areas;

.7 chart scale boundaries;

.8 indication of cautionary notes;

4.10.2.3 All other information:

.1 spot soundings;

.2 underwater cables and pipelines;

.3 ferry routes;
.4 details of all isolated dangers;
.5 details of aids to navigation;
.6 contents of cautionary notes;
.7 ENC edition date;
.8 geodetic datum;
.9 magnetic variation;
.10 graticule;
.11 place names.

4.10.3 ECDIS is to present the standard display at any time by the operator's single action.

4.10.4 When a chart is first displayed on ECDIS, it is to provide the standard display at the largest scale available in SENC for the displayed area.

4.10.5 Addition or removal of information from ECDIS display is to be performed by not more than three single actions of the operator. It is not to be possible to remove information contained in the display base.

4.10.6 It is to be possible to select a safety contour from the depth contours provided by SENC. ECDIS is to emphasize the safety contour over other contours on the display.

4.10.7 It is to be possible to select a safety depth. ECDIS is to emphasize soundings equal to or less than the safety depth whenever spot soundings are selected for display.

4.10.8 ENC and all updates thereto are to be displayed without any quantitative degradation of their information content when compared with the standard test chart edited by an authorized hydrographic office.

4.10.9 ECDIS is to ensure that ENC and all updates thereto have been correctly loaded into SENC.

4.10.10 ENC and all updates thereto are to comply with the international requirements for colours and symbols and be quite different from the following navigational elements and parameters displayed:

.1 own ship;
.2 past track with:
time marks for primary track;
time marks for secondary track;
.3 vector for course and speed (over the ground);
.4 variable range marker and/or electronic bearing line;
.5 cursor;
.6 event;
.7 dead reckoning position of the own ship with:
time mark ignoring wind and stream;
time mark allowing for drift;
.8 estimated position and time;
.9 fix and time;
.10 transferred position line and time;
.11 tidal stream or current vector with effective time and strength (in box):
predicted;
actual;
.12 danger highlight;
.13 clearing line;
.14 planned course and speed (speed is shown in box);
.15 waypoint;
.16 distance to run;
.17 planned position with date and time;
.18 visual limits of lights are to show rising/dipping range;
.19 position and time of "wheelover".

4.10.11 The chart information to be used in ECDIS is to be the latest edition of that originated by an authorized hydrographic office and the list of system charts by their dates and editions are to be definitely indicated in ENC. The list of charts in ECDIS is to be available at the operator's request. The new ENC edition is to revoke and substitute the previous one and updates thereto issued by an authorized hydrographic office.

4.10.12 SENC content is to be adequate and uptodate for the intended voyage.

4.10.13 It is not to be possible to alter ENC content.

4.10.14 Updates are to be stored separately from ENC and the same information carrier may be used.

4.10.15 ECDIS is to be capable of accepting official updates to ENC data provided in conformity with International Hydrographic Organization (IHO) standards. These updates are to be automatically applied to SENC with the earlier updates being already entered into the system. By whatever means updates are received, the implementation procedure is not to interfere with the display in use.

4.10.16 ECDIS is to be capable of accepting updates to ENC data entered manually with simple means for verification prior to the final acceptance of the data. They are to be distinguishable on the display from ENC information and its official updates and are not to affect display legibility.

4.10.17 ECDIS is to keep a record of updates including time of application to SENC.

4.10.18 ECDIS is to allow to display updates in order to review their contents and to ascertain that they have been included in SENC.

4.10.19 ECDIS is to provide the relevant indication if:
.1 the information is displayed at a larger scale than that contained in ENC;
.2 own ship's position is covered by ENC at a larger scale than that provided by the display.

4.10.20 Radar information or other navigational information may be added to ECDIS display. However, it is not to degrade SENC information and is to be clearly distinguishable from SENC information.

4.10.21 ECDIS and added navigational information are to use a common reference system. If this is not the case, an indication is to be provided.

4.10.22 Transferred radar information may contain both the radar image and ARPA information.

4.10.23 The radar image and the chart are to match in scale, orientation and projection.

4.10.24 The radar image and the position from the position sensor both are to be adjusted automatically for antenna (of radar and the relevant receiver) offset from the control station.

4.10.25 It is to be possible to adjust the displayed position of the ship manually in a quick and simple manner so that the radar image may match SENC display. Besides, there are to be provided:

a clear indication of distance and bearing drift performed;

an indication in compliance with the requirements in 4.10.21.

4.10.26 It is to be possible to remove the radar or plotting information by the operator's single action.

4.10.27 It is to be possible to display SENC in a "north up" orientation and to use true motion mode. Other orientations and modes are allowed.

4.10.28 When true motion is in use, reset and generation of the neighbouring area are to take place automatically at a distance from the border of the display determined by the operator.

4.10.29 It is to be possible to change manually the chart area and the position of the own ship relative to the edge of the display.

4.10.30 IHO recommended colours and symbols are to be used to represent SENC information.

SENC information when displayed at the scale specified in ENC is to use the size of symbols, figures and letters recommended by IHO.

4.10.31 For the description of navigational elements and parameters given in 4.10.10 colours and symbols which are distinguishable from chart symbols are to be used.

4.10.32 ECDIS is to allow to select whether the own ship is displayed in true scale or as a symbol.

4.10.33 ECDIS is to be capable of displaying information for:

.1 route planning and supplementary navigation tasks;

.2 route monitoring.

4.10.34 The effective size of the chart presentation for route monitoring is to be at least 270 mm by 270 mm.

4.10.35 The display is to be capable of meeting colour and resolution recommendations of IHO.

4.10.36 The information displayed by ECDIS is to be clearly visible to at least two operators in the conditions of light normally experienced on the bridge of the ship in the day time and at night.

4.10.37 ECDIS is to allow route planning and route monitoring to be performed in a simple and reliable manner. Besides, it is to be designed for user-friendly operation.

4.10.38 The largest scale information available in SENC for the area given is to be used by ECDIS for all alarms and indications of crossing the ship's safety contour for which special conditions exist. Areas, for which special conditions exist, are as follows:

.1 traffic separation zone;

.2 traffic routeing scheme crossing or roundabout;

.3 traffic routeing scheme precautionary area;

.4 two-way traffic route;

.5 deepwater route;

.6 recommended traffic lane;

.7 inshore traffic zone;

.8 fairway;

.9 restricted area;

.10 caution area;

.11 offshore production area;

.12 areas to be avoided;

.13 military practice area;

.14 seaplane landing area;

.15 submarine transit lane;

.16 ice area;

.17 channel;

.18 fishing ground;

.19 fishing prohibited;

.20 pipeline area;

.21 cable area;

.22 anchorage prohibited area;

.23 dumping ground;

.24 spoil ground;

.25 dredged ground;

.26 cargo transshipment area;

.27 incineration area;

.28 specially protected areas.

4.10.39 When route planning is carried out, ECDIS is to be capable of:

.1 including both straight and curved segments;

.2 adjusting a planned route by:

adding waypoints to a route;

deleting waypoints from a route;

changing the position of the waypoints;

changing the order of the waypoints in the route (including back route planning);

.3 planning an alternate route in addition to the selected route. The selected route is to be clearly distinguishable from the other route;

.4 indicating that a route is planned across the own ship's safety contour or across the boundary of a prohibited area, or of a geographical area, for which special conditions exist (refr to 4.10.38);

.5 specifying a limit of deviation from the planned route.

4.10.40 For route monitoring ECDIS is to be capable of:

.1 displaying the selected route and the own ship's position whenever the display covers that area;

.2 giving an alarm or indication if, within a specified time set by the operator, the own ship may cross the safety contour or the boundary of a prohibited area, or of a geographical area, for which special conditions exist (see 4.10.38);

.3 giving an alarm if the limit for deviation from the planned route, set by the operator, is exceeded;

.4 displaying a sea area that does not have the ship on the display. If this is done on the display used for route monitoring, the automatic route monitoring functions (updating the ship's position, providing alarms and indications) are to be continuous. The return to the route monitoring display covering the own ship's position are to be carried out by the operator's single action.

4.10.41 ECDIS is to be capable of displaying the ship's position derived from a continuous positioning system of an accuracy consistent with the relevant requirements specified for inland navigation. A second independent positioning method of a different type may be provided. ECDIS is to be capable of identifying discrepancies between the two systems and of switching from one positioning system to another with the relevant indication for both systems.

4.10.42 ECDIS is to provide:

.1 an indication when the input from the position fixing system fails;

.2 a repeat of any alarm and indication passing to it from a position fixing system.

4.10.43 An alarm is to be given in ECDIS if the ship, within a specified time or a distance set by the operator, reaches a critical point on the planned route.

4.10.44 The positioning system and SENC are to be on the same geodetic datum. ECDIS is to give an alarm if this is not the case.

4.10.45 During voyage ECDIS is to provide:

.1 simultaneous displaying the selected and alternative routes with the selected route clearly distinguishable form the other routes;

.2 a possibility to modify the selected route;

.3 a possibility to change to an alternative route;

.4 displaying timelabels along the ship's track manually on demand and automatically at intervals selected between 1 and 120 minutes;

.5 displaying the free movable electronic bearing lines, variable and fixed range markers and other symbols of navigational elements and parameters required in 4.10.10.

4.10.46 When route monitoring is carried out, ECDIS is to provide a possibility to:

.1 enter the geographical coordinates of any position and display it;

.2 select any point (feature, symbol or position) on the display and read its geographical coordinates.

4.10.47 ECDIS is to provide a possibility to adjust the ship's geographical position manually. This manual adjustment is to be noted alphanumerically on the screen, maintained until altered by the operator or automatically recorded.

4.10.48 ECDIS is to store and be able to reproduce the information required to reconstruct the operator's actions and verify the official database within the previous 12 hours during which the following data is to be recorded at one minute intervals:

position, time, heading and speed of the own ship;

ENC source, edition, date, cell and update history.

ECDIS is to record the complete track for the entire voyage with time marks at intervals not exceeding 4 hours.

It is not to be possible to change the recorded information.

ECDIS is to have a capability to preserve the record of the previous 12 hours and of the voyage track.

4.10.49 The accuracy of all calculations performed by ECDIS is to be independent of the characteristics of the output device and is to be consistent with SENC accuracy.

Bearings and distances drawn on the display and those measured between elements of the used chart are to have an accuracy no less than that afforded by the resolution of ECDIS display.

4.10.50 ECDIS is not to degrade the performance of any equipment providing sensor inputs.

Optional equipment connected to ECDIS is not to degrade its performance.

4.10.51 It is to be possible to connect to ECDIS the systems providing continuous position fixing.

4.10.52 ECDIS is to be provided with means for either automatically or manually carrying out onboard tests of major functions. In case of a failure, the test is to display information to indicate which module is at fault.

Major functions tests are to include checking the correctness of data provided by input sensors. If the cause of wrong data provided by sensors is identified, ECDIS is to be capable of displaying the relevant clear indications.

4.10.53 ECDIS is to provide a suitable alarm and indication of system malfunction.

4.10.54 ECDIS changing from one source of power supply to another or any interruption of the supply for a period of up to 45 s is not to require the equipment to be manually reinitialized; during a temporary non-supply the continuation of ECDIS functioning is not required.

4.10.55 Back-up arrangements are to be provided to ensure safe navigation in case of ECDIS failure.

A set of updated paper navigation charts for the planned voyage or a back-up electronic chart display navigation system (BECDNS) may be used as back-up arrangements. The transfer from the main system to the back-up system (BECDNS) is to be automatic without loss of navigational information.

In addition to the requirements of 4.10.3, 4.10.19, 4.10.27 to 4.10.31, 4.10.33 to 4.10.38, 4.10.42 to 4.10.44, 4.10.49 to 4.10.51, 4.10.53 and 4.10.54, the back-up electronic chart display navigation system is to meet the following requirements:

.1 the chart information to be used in BECDNS is to be the latest edition of that originated by a government hydrographic office. The list of the charts in BECDNS is to be presented on the user's request;

.2 the information displayed by BECDNS is to be at least equivalent to the standard display in accordance with 4.10.2;

.3 provision is to be made for route planning functions, including:

taking-over the route monitoring originally performed by ECDIS;

adjusting a planned route;

plotting the own ship's position automatically or manually on a chart;

taking courses, distances and bearings from the chart;

displaying the planned and covered route;

displaying time labels along the ship's track;

setting the values of safe contour and safe depth;

.4 use of the radar with selected parts of ENC chart information overlay as an element of the back-up is allowed; the radar is to comply with the requirements of 4.5;

.5 the own ship's position, time, course and speed are to be recorded with an interval of 1 minute during at least 4 hours.

4.11 HEADING CONTROL SYSTEM

4.11.1 The heading control system is to enable the ship to keep a preset heading with minimum operation of the ship's steering gear.

4.11.2 The heading control system is to automatically keep the ship on a preset heading with an accuracy at which an average heading value may differ from the preset value not more than by ±1° at a speed providing the ship's normal manoeuvrability. The maximum amplitude of yaw is not to exceed that allowed under manual control.

4.11.3 The heading control system is to be able to perform turns based either on a preset turning radius or a preset rate of turn.

The heading control system may work together with a track control system adjusting its preset heading or drift angle.

4.11.4 The heading control system is to change to a preset heading without significant overshoot (yaw).

4.11.5 Provision is to be made in the heading control system for manual change of the heading in the automatic mode without change-over to manual steering.

Two remote stations for manual steering are recommended for the heading control system to make possible an emergency change of the ship's heading from these stations when the system operates in the automatic mode. A single change in the ship's heading in either direction is not to be limited, up to a complete turning. The design of the remote stations for manual steering is to be such that after putting the manual control at the station in the neutral position the ship is to keep the preset heading and further operation of the system in the automatic mode is to be maintained.

The steering wheel, handle or push-buttons may be used as a manual control.

4.11.6 A repeater of the gyrocompass or magnetic compass, indicators of the rudder preset and true positions, controls for switching on power supply to the entire heading control system and steering gear motors, sensitivity switches and steering mode change-over controls for presetting the ship's turning radius or rate of turn, signal lamps and other controls required for operation of the system are to be installed on the control desk of the system.

It is to be possible to vary illumination of the controls and indicators installed on the control desk of the system.

4.11.7 The heading control system is to be capable of adapting manually or automatically to different steering characteristics of the ship under various speed and loading conditions depending on weather, and to provide reliable operation under normal operating conditions.

4.11.8 The heading control system is to prevent unnecessary activation of the rudder due to normal yaw motion in a seaway and to enable to preset the maximum rudder angle with indication when the angle of limitation has been reached.

4.11.9 Any inadvertent alteration of the preset heading is to be prevented.

4.11.10 The system is to enable change-over from automatic to manual steering and vice versa by a single control located in an easily accessible position. The following requirements are to be met:

.1 change-over is to be possible at any position of the rudder, including any failure in the automatic control system;

.2 change-over is to be effected by one manual control within 3 seconds;

.3 adequate indication is to be provided to show which method of steering is in operation.

4.11.11 When changing-over from manual to automatic control the heading control system is to take over the actual heading as the preset heading.

4.11.12 If the heading control system works as part of a track control system, then switching from track control to automatic heading control is to be provided in the event of any failure in the track control system. The actual heading at the moment of switching is to be taken as the preset heading.

Any inadvertent switching back to track control is to be prevented.

4.11.13 The heading control system is to be totally self-synchronizing and is not to require any adjustments when a steering mode is changed-over.

The manual steering system built-in the integrated bridge heading control system is to be simple, reliable and not to use elements of the automatic steering system and is also to provide follow-up mode of the system operation.

4.11.14 An alarm both audible with mute function and visual is to be provided in order to indicate failure or reduction in the power supply to the heading control system or heading monitor, as well as when the actual heading deviates from the preset heading beyond a preset limit.

4.11.15 In case two independent compasses are available, the following is to be provided:

an alarm both audible with mute function and visual when the preset value of permissible discordance between readings of operating and back-up heading monitors is reached;

a clear indication on the actual heading source.

The heading monitor may be a separate device and is not required to be an integral part of the heading control system.

4.11.16 The heading control system is to provide an alarm on a failure of any information sensor used in the steering process. All emergency alarms likely to be activated in connection with sensor operation are to be duplicated on the control desk of the heading control system.

4.11.17 Where the system is not capable for adapting automatically to different environmental conditions and steering characteristics, adequate means for manual adjustments are to be provided on the front panel of the system control desk.

4.11.18 Normal alterations of heading are to be possible by adjustment of one control only (steering wheel, handle, push-button).

Alteration of the preset heading to starboard is to be effected by turning the heading setting control clockwise or tilting it to the right-hand side.

Alteration of the preset heading to port side is to be effected by turning the heading setting control counter-clockwise or tilting it to the left-hand side. Actuation of any other control is to affect the preset heading of the ship.

4.11.19 Where remote control stations are provided, facilities for the delegation of control to remote station are to be incorporated in the master station.

Controls at remote positions are to be similar to those on the master station and to have illumination which may be varied as required by 4.11.6.

4.11.20 Provision is to be made for connection of the heading control system with suitable source of speed information.

Connection of the heading control system with information sources is to be in compliance with 4.1.31.

PART XIII. MEANS FOR THE PREVENTION OF POLLUTION FROM SHIPS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part apply to the ships under construction specified in 1.3.1, Part I "Classification".

1.1.2 The requirements of the present Part apply, as far as reasonable and practicable, to ships in service to the extent defined by the relevant provisions of the Parts of the Rules and the relevant national regulating documents.

1.2 DEFINITIONS AND EXPLANATIONS

1.2.1 The definitions and explanations relating to the general terminology of the Rules are given in Part I "Classification".

In the present Part the following definitions and explanations have been adopted.

Administration is the Government of the State under whose authority the ship is operating. With respect to a ship entitled to fly a flag of any State, the Administration is the Government of that State.

Harmful substance is any substance which, if introduced into the sea, is liable to create hazards to human health, harm living resources and marine life, damage amenities or to interfere with other legitimate uses of the sea.

Reception facilities are floating or stationary structures for the reception of all kinds of pollution substances from ships for subsequent discharge, filtration, utilization, etc.

Discharge in relation to harmful substances or effluents containing such substances is any release howsoever caused from a ship and includes any escape, disposal, spilling, leaking, pumping, emitting or emptying.

Discharge does not include:

dumping within the meaning of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972; or

release of harmful substances for purposes of legitimate scientific research into pollution abatement or control.

Ship is a vessel of any type whatsoever navigating within inland waterways.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 The following equipment is subject to the Register technical supervision during manufacture: equipment for the prevention of pollution from ships specified in Section 5 (regarding diesel internal combustion engines) and in Section 17, Part IV "Technical Supervision during Manufacture of Products" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, whichever is applicable.

1.3.2 The scope of technical supervision during ship's construction is specified in Section 17, Part V "Technical Supervision during Construction of Ships" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

2 SHIP'S CONSTRUCTIONS, EQUIPMENT AND ARRANGEMENTS FOR THE PREVENTION OF POLLUTION BY OIL

2.1 DEFINITIONS AND EXPLANATIONS

2.1.1 In the present Section the following definitions and explanations have been adopted.

Wing tank is any tank adjacent to the side shell plating.

Lightweight is the displacement of a ship in metric tons without cargo, fuel, lubricating oil, ballast water, fresh water and feed water in tanks, consumable stores, and passengers and crew and their effects.

Cargo tank — refer to the definition in 1.1.1.4, Part II "Hull".

Deadweight (*DW*) is the difference in tons between the displacement of a ship in water of a density of 1,025 t/m^3 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the ship.

Length (*L*) is 96 per cent of the total length on a waterline at 85 per cent of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured is to be parallel to the designed waterline. The length (*L*) is to be measured in metres.

Fuel oil is heavy distillates or residues from crude oil or blends of such materials intended for use as a fuel for the production of heat or power of a quality equivalent to the specification acceptable to IMO.

Segregated ballast is the ballast water introduced into a tank which is completely separated from the cargo oil fuel system and which is permanently allocated to the carriage of ballast or to the carriage of ballast or cargoes other than oil or noxious liquid substances.

Combination carrier — refer to the definition in 1.1.2, Part I "Classification".

Instantaneous rate of discharge of oil content is the rate of discharge of oil in litres per hour at any instant divided by the speed of the ship in knots at the same instant.

Amidships is at the middle of the length (*L*).

Oil tanker is a ship constructed or adapted primarily to carry oil in bulk in its cargo spaces and includes ships of **N** and **C** types as defined in 1.1.2, Part I "Classification".

Oily mixture is a mixture with any oil content.

Oil-containing bilge water is a mixture of water and any quantity of oil formed in the course of operation of a ship, except for cargo waste.

Oil is petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than petrochemicals which are subject to the provisions of Annex II to MARPOL 73/78) and, without limiting the generality of the foregoing, includes the substances listed in Appendix I of Annex I to MARPOL 73/78.

Heavy grade oil:

crude oils having a density at 15 °C higher than 900 kg/m^3;

oils, other than crude oil, having either a density at 15 °C higher than 900 kg/m^3 or a kinematic viscosity at 50 °C higher than 180 mm^2/s; or

bitumen, tar and their emulsions.

Oil fuel is any oil used as fuel in connection with the propulsion and auxiliary machinery of the ship in which such oil is carried.

Sludge is part of oil which due to its consistence is not liable to conventional pumping or processing and requires special methods and devices for disposal from the ship.

Oil residues are separated sludge, exhausted lubricating oil, oil from bilge water separators, leakages of fuel and lubricating oil.

Forward and after perpendiculars are to be taken at the forward and after ends of the length (*L*). The forward perpendicular is to coincide with the foreside of the stem on the waterline on which the length is measured.

Volumes and areas in a ship are to be calculated in all cases to moulded lines.

Exhausted oil is exhausted lubricating oil, hydraulic oil or other hydrocarbon based liquids, which are not suitable for use in machinery due to deterioration and contamination.

Separated sludge is sludge resulting from purification of fuel and lubricating oil.

Slop tank is a tank specifically designated for the collection of tank drainings, tank washings and other oily mixtures.

Constructed ship is a ship the keel of which is laid or which is at a similar stage of construction.

15 ppm bilge separator is any combinations of a separator, filter or coalescer, and also a single unit designed to produce an effluent with oil content not exceeding 15 ppm.

15 ppm bilge alarm is a device giving off a signal whenever the oil content in the effluent exceeds 15 ppm.

Oil residues incinerators are the following:

main and auxiliary steam boilers with appropriate oil residues processing systems;

heaters of thermal liquid systems with appropriate oil residues processing systems;

incinerators with appropriate oil residues processing systems designed for residues incineration;

inert gas systems with appropriate oil residues processing systems.

Crude oil is any liquid hydrocarbon mixture occurring naturally in the earth whether or not treated to render it suitable for transportation and includes:

crude oil from which certain distillate fractions may have been removed;

crude oil to which certain distillate fractions may have been added.

Oil-containing bilge water holding tank is a tank for collecting and accumulating oil-containing bilge water.

Oil residues holding tanks are the following tanks:

separated sludge tanks;

tanks for collecting fuel and lubricating oil leakages;

tanks for collecting exhausted oil.

Centre tank is any tank inboard of a longitudinal bulkhead.

Breadth (*B*) is the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material. The breadth (*B*) is measured in metres.

2.2 GENERAL

2.2.1 Any self-propelled ship specified in 1.3.1, Part I "Classification" and having installations which use liquid fuel on board are to be equipped with:

.1 oil-containing bilge water holding tank;

.2 standard discharge connections for oil-containing bilge water/oil residues discharge to reception facilities;

.3 system for collecting oil-containing bilge water into the holding tanks and their discharge to reception facilities;

.4 holding tank for storage of spent oils with total capacity corresponding to at least 1,5 times the quantity of the spent oils from the sumps of all of the internal combustion engines and all of the equipment installed, together with the hydraulic-fluid installations. If the ship is equipped with a common holding tank for collecting and storage of the spent oils and other oil residues its capacity is to be increased taking into consideration 2.6.1 and 2.6.9;

.5 oil residues holding tank equipped with a system for collecting oil residues and their discharge to reception facilities except ships of less than 400 gross tonnage with a total power of all main internal combustion engines of less than 220 kW or dynamically supported craft;

.6 when the necessary endurance of the ship is not ensured due to insufficient capacity of tanks for collecting oil-containing bilge water or the engine room bilges of the ships specified in 2.2.3, additionally with a bilge water separator, a 15 ppm alarm and an automatic stopping device.

2.2.2 Any non-self-propelled having installations which use liquid fuel on board are to be equipped in accordance with 2.2.1.2; 2.2.1.4 and 2.2.1.5. For such ships the engine room bilges may be considered as a collecting reservoir for oil-containing bilge water.

2.2.3 On self-propelled ships with a total power of all main internal combustion engines of less than 220 kW or on high-speed craft the engine room bilges may be considered as a collecting reservoir for oil-containing bilge water with their further discharge to the reception facilities.

2.2.4 Cargo and fuel oil tanks are not to be used for ballast purposes.

2.3 REQUIREMENTS FOR OIL TANKERS

2.3.1 Segregated ballast tanks.

2.3.1.1 Segregated ballast tanks are to be provided on oil tankers.

2.3.1.2 Segregated ballast tanks are to be provided with independent ballast pumps and pipelines intended exclusively for the ballast water intake and discharge.

2.3.1.3 Provision may be made for emergency discharge of the segregated ballast by means of a connection to a cargo pump through a portable spool piece.

In this case non-return valves are to be fitted on the segregated ballast connections to prevent the passage of oil to the segregated ballast tanks. The portable spool piece is to be mounted in a conspicuous position in the pump room and a permanent notice restricting its use is to be prominently displayed adjacent to it.

2.3.2 Cargo tanks. requirements for double hulls of oil tankers.

2.3.2.1 Each oil tanker as regards limitations of size, construction and arrangement of cargo tanks, as well as pipelines connecting cargo tanks and pipelines running through cargo tanks is to comply with the requirements of Part II "Hull", Part III "Equipment, Arrangements and Outfit", Part VII "Systems and Piping" and Part XIV "Requirements for Ships Carrying Dangerous Goods" whichever is applicable.

2.3.2.2 Each oil tanker as regards the requirements for double hull is to comply with the requirements of Part II "Hull", Part XIV, "Requirements for Ships Carrying Dangerous Goods" and 2.3.2.4 of the present Part.

2.3.2.3 In addition to 2.3.2.2, each oil tanker of more than 110 m in length , irrespective of the carried cargo denomination, is to be built as a double hull ship in accordance with 3.1, Part II "Hull".

2.3.2.4 Oil tankers carrying heavy grade oil as regards construction and arrangement of cargo tanks are to correspond to Type **C** oil tankers.

2.3.2.5 On oil tankers of 5000 t deadweight and above cargo pump rooms are to be provided with a double bottom in accordance with the following requirements:

.1 the pump room is to be provided with a double bottom such that at any cross-section the depth of each double bottom tank or space is to be such that the distance h between the bottom of the pump room and the ship's base line measured at right angles to the ship's base line is not less than 0,6 m;

.2 ballast pumps are to be provided with suitable arrangements to ensure sufficient suction from double bottom tanks;

.3 the ballast system pipelines may be fitted within the double bottom of cargo pump rooms, provided that any damage to these pipelines is not affect the cargo system operation;

.4 suction wells within the double bottom of the cargo pump rooms are to be as small as practicable, and the distance between the well bottom and the ship's base line measured at right angles to the ship's base line is to be not less than 0,5 m;

.5 the double bottom protecting the cargo pump-room may be formed by a dry compartment, ballast tank, or, if it is not prohibited by other regulations, a fuel oil tank;

.6 in case of pump rooms whose bottom or part thereof being the ship's bottom plating is located above the ship's base line by at least the minimum height required in 2.3.2.5.1, there will be no need for a double bottom construction in way of the pump room or part thereof.

In case the part of the pump room is located below the minimum height, this part of the pump room is to serve as a double bottom protecting the above part of the pump room.

2.4 REQUIREMENTS FOR HOLDING TANKS

2.4.1 Holding tanks may be built-in or independent. The construction of holding tanks is to comply with the requirements of Part II "Hull".

2.4.2 Holding tanks are to be fitted with:

.1 an orifice for access and cleaning;

.2 a breather pipe with a flame-arrester leading to the open air;

.3 a device which activates optical and acoustic signals in the wheelhouse or the central control station when the level of the liquid reaches 80 per cent of the tank capacity;

.4 a device for measuring the level of the liquid;

.5 holding tanks on ships using heavy fuel, tanks for collecting separated sludge (irrespective of the fuel relative density), or holding tanks installed in the place where negative temperatures are possible during operation are to be fitted with a heating facility.

2.5 OIL-CONTAINING BILGE WATER HOLDING TANKS

2.5.1 The calculation of the capacity of the oil-containing bilge water holding tank of ships referred to in 2.2.1, agreed with the customer, with regard to the intended area of navigation and service conditions, as well as sterntube gear arrangement particulars are to be submitted to the Register.

2.5.2 On ships where a 15 ppm bilge separator is not provided, the tank capacity, in m^3, is to be not less than calculated by the following formula:

$$V = 0{,}35KT \qquad (2.5.2)$$

where K = factor equal to:
for main engine power of less than 110 kW – 0,4;
for power from 111 to 220 kW – 0,8;
for power from 221 to 440 kW – 1,2;
for power from 441 to 735 kW – 1,6;
for power more than 735 kW – 2,0;
T = maximum duration of voyage between ports where oil-containing bilge water may be discharged to reception facilities, in days (where the voyage duration is not known it is to be adopted not less than 7 days).

2.5.3 On ships where a 15 ppm bilge separator is provided the tank capacity is to be not less than 50 per cent of the value calculated according to the Formula (2.5.2).

2.6 OIL RESIDUES HOLDING TANKS

2.6.1 Having regard to the type of machinery and length of voyage, the minimum capacity of the oil residues holding tank specified in 2.2.1.5, in m^3, is to be calculated by the following formula:

$$V = KCD \qquad (2.6.1)$$

where K = factor equal to:
0,015 — for ships where heavy fuel oil is purified for main engine use;
0,005 — for ships using diesel oil or heavy fuel oil which does not require purification before use;
C = daily fuel consumption, in m^3;
D = maximum duration of voyage between ports where oil residues may be discharged to reception facilities, in days (where the voyage duration is not known it is to be adopted not less than 7 days).

Where such ships are fitted with oil residues incinerators or other arrangements for oil residues incineration on board approved by the Register:

V = 50 per cent of the value determined by the Formula (2.6.1), or

$V = 1$ m^3, for ships of 400 gross tonnage and above but less than 4000 gross tonnage, or 2 m^3 for ships of 4000 gross tonnage and above whichever is greater.

2.6.2 The inner surfaces of the bottom and vertical walls of the oil residues tank except for the built-in tanks referred to in 2.4.1 are to be smooth (external framing). In this case the bottom is to be inclined towards the spool piece.

2.6.3 If a tank is fitted with a tank heating system, the heating pipes are to be arranged such that, seen from the heating inlet, to start with, they are arranged in a way of the boundaries and then across the whole bottom area sufficiently high, in order to avoid being covered totally by sediments in the tank.

The tank heating system is to be designed such as to enable heating of the oil sludge up to 60 °C.

The suction line from the tank to the pump is to be provided with heat tracing.

The use of electrical heaters is subject to special consideration by the Register.

2.6.4 The oil residues holding tank is to be fitted, in its upper part, with steaming-out lines for cleaning.

2.6.5 The pipeline system of the oil residues holding tank is to be provided with a pump intended to discharge the tank contents to the reception facilities and complying with the requirements of 2.6.13.

2.6.6 The pressure side of pumps of the system referred to in 2.6.5 are not to be connected to the bilge water pipeline except for the common pipeline to the standard discharge connections referred to in 2.7.2.1.

However arrangements may be provided to discharge settled water from oil residues holding tanks by means of manually operated self-closing valves or similar arrangements.

2.6.7 Piping to and from oil residues holding tanks are to have no direct connections overboard, other than the common pipeline to standard discharge connections in accordance with 2.7.2.1.

2.6.8 Oil residues holding tanks are to be designed and constructed so as to facilitate their cleaning and the discharge of oil residues to reception facilities.

2.6.9 A separate drain and leakage oil tank(s) capacity is to be calculated according to the Formula (2.6.9). The oil being discharged from the 15 ppm bilge separator (if available) may also be discharged to this tank.

$$V_{\text{HO}} = 20DP/10^6 \qquad (2.6.9)$$

where P = main engine rating, in kW;
D = maximum duration of voyage between ports where drain and leakage oil may be discharged to reception facilities, in days (where the voyage duration is not known it is to be adopted equal to 7 days).

2.6.10 The separated dirty water and exhausted control water of fuel oil purifiers are to be discharged into a particular tank for this purpose in order to minimize the influx to the separated sludge tank. This particular tank is to be located above the double bottom for the purpose of facilitating its drain without the need of a drain pump.

If the separated dirty water and exhausted control water from purifiers are not discharged to a particular tank, and in lieu of this to a separated sludge tank, the tank is to be located:

.1 above the double bottom to provide the discharge of settled water without using pumps, by means of valves specified in 2.6.6.

. 2 in the double bottom if sufficient capacity is provided for collection both of the separated sludge and the separated dirty water and exhausted control water.

2.6.11 The separated sludge tank is to be located below the heavy fuel oil purifier. If this is not possible, the separated sludge tank is to be located close to the heavy fuel oil purifier in such a way that the discharge line to the tank can be installed at the maximum gradient. The pipelines, whenever possible, are to be straight or fitted with large radius elbows.

2.6.12 The oil residues (separated sludge) holding tank is to be designed so that oil residues (separated sludge) have free access to the suction line. If this is not possible, the suction opening or the submersible pump are to be arranged so that the oil residues path to the suction opening is as short as possible.

2.6.13 The pump is to be suitable, if applicable, for transferring high viscosity oil residues, is to be a self-priming displacement pump, with suitable protection against dry running and have a sufficient total head.

The delivery rate, in m3/h, may be calculated by the formula

$$Q = V/t \qquad (2.6.13)$$

where V = capacity of the oil residues holding tank which is calculated by the Formula (2.6.1);
t = time of discharge within 4 to 8 hours.

The pressure side of the pump is only to be connected to the pipes leading to the deck, to oil residues holding tanks and to oil residues incinerators if they are installed on board.

2.7 PUMPING AND DISCHARGE ARRANGEMENTS FOR OILY MIXTURES

2.7.1 Oil tankers.

Equipment and arrangements for pumping and discharge of oily mixtures from oil tankers, as well as from ships fitted with cargo spaces which are constructed and utilized to carry oil in bulk of aggregate capacity of 200 m^3 and above are to include the following:

.1 discharge manifolds for the discharge of oily mixtures from cargo and slop tanks to reception facilities;

.2 means to drain all cargo pumps and oil pipelines at the completion of cargo discharge;

.3 stripping devices;

.4 every oil tanker of 150 gross tonnage and above which has installed a sea chest that is permanently connected to the cargo pipeline system, is to be equipped with both a sea chest and an inboard isolation valve. In addition to these valves, the sea chest is to be capable of isolation from the cargo piping system by use of a spectacle flange with a nameplate installed in the pipeline system in order to prevent, under all circumstances, the section of pipeline between the sea-chest valve and the inboard valve being filled with cargo.

2.7.2 All ships including oil tankers.

2.7.2.1 In every ship provision is to be made for a pipeline to discharge oil-containing bilge water of machinery spaces and oil residues to the reception facilities the discharge connections of which are to have flanges of standard dimensions in accordance with Fig. 2.7.2.1 or quick-release type connections conforming to the EN 1305:1996 standard. The pipeline is to be led to both sides of the ship.

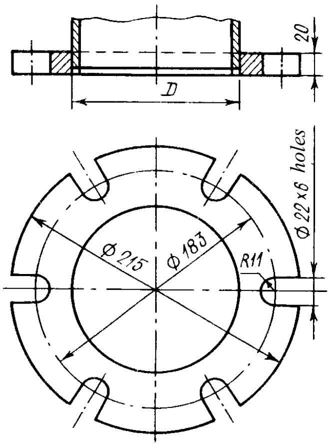


Fig. 2.7.2.1

Note. The flange is intended for pipes with an internal diameter of 125 mm and is to be manufactured from steel or an equivalent material with a flat machined surface. The flange, together with a gasket of oil-resistant material, must be designed for a working pressure of 0,6 MPa. Coupling is effected by means of six 20 mm diameter bolts of the requisite length.

In well grounded cases, on agreement with the Register, the pipeline may be led to one side of the ship.

Discharge manifolds are to be located in places convenient for connection of hoses and are to have nameplates. Discharge manifolds are to be provided with blank flanges.

The pipelines to standard discharge connections for discharge of oil-containing bilge water of machinery spaces and oil residues are not to be connected to the oil fuel supply pipeline system.

2.7.2.2 Starting and stopping of the discharge arrangements is to be effected manually.

2.7.2.3 In the vicinity of discharge manifolds provision is to be made for the discharge observation and remote cut-off position or the effective communication system (telephone or radio) between the observation position and the discharge control position.

On agreement with the Register, ships of less than 24 m in length may not be provided with discharge observation and remote cut-off position or the effective communication system between the observation position and the discharge control position.

In the vicinity of discharge manifolds, provision is to be made to prevent pollution in case of oily mixtures leakage, e.g., placing drip-trays, equipping the places of discharge with leaktight coamings, arranging enclosed spaces (stations).

2.7.2.4 Closing arrangements of oil-containing bilge water discharge pipelines is to be capable of being sealed.

2.8 OTHER MEANS FOR REMOVAL OF OIL RESIDUES

2.8.1 Other means for removal of oil residues are oil residues incinerators as defined in 2.1.1.

2.8.2 Oil residues incinerator systems are to consist of the following:

steam boiler or heater of thermal liquid systems or incinerator;

oil residues processing system.

2.8.3 Oil residues processing system is to consists of the following:

a tank for mixing oil residues with oil fuel (mixing tank);

oil residues preheating system;

filter; and

homogenization system.

2.8.4 The mixing tank is to be equipped with suitable drainage facilities and an oil fuel supply connection is to be provided.

2.8.5 The homogenization system is to assure that the entire contents of the mixing tank are processed into a homogeneous and combustible mixture. This system is to be put into operation following adequate draining of the tank. A device for continuous indication and monitoring of the water content of the oil residues is to be provided.

2.9 15 PPM BILGE SEPARATORS

2.9.1 A 15 ppm bilge separator is to be of an approved type and provide the degree of cleaning according to the international standards[1] which are currently in force.

[1] Refer to Technical specifications adopted by Resolution MEPC.107(49), "Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Spaces of Ships" (taking into consideration the provisions of MEPC.1/Circ.643).

2.9.2 If, upon the results of the samples analyses carried out at a recognized laboratory, the 15 ppm bilge separator proves not to provide an oil content in the effluent as specified by the standards referred to in 2.9.1, the operation of the 15 ppm bilge separator is to be prohibited, and the closing arrangements at the outlet of the cleaned oil-containing bilge water effluent are to be sealed. To resume the ship operation, the calculations proving sufficient capacity of the tanks for collecting oil-containing bilge water are to be submitted to the Register. The documents previously issued by the Register are to be reissued taking into consideration the changes which took place in the ship's equipment.

2.9.3 15 ppm bilge separators are to be in compliance with the technical specifications adopted under Resolution MEPC.107(49).

2.9.4 Re-circulating facilities are to be provided, after and adjacent to the overboard outlet of the automatic stopping device, to enable the 15 ppm bilge separator system, including the 15 ppm bilge alarm and the automatic stopping device, to be tested with the overboard discharge valve closed.

2.9.5 The pipelines for discharge of cleaned water after the 15 ppm bilge separator are not to have connections with bilge (including bilge water pipeline system) and ballast system, except for the outlet specified in 2.9.4 and the re-circulation pipeline after the automatic stopping device. Re-circulating facilities for oil-containing bilge water is to exclude any by-pass of the 15 ppm bilge separator.

2.9.6 In a vertical section of the piping for discharge of cleaned water, after the 15 ppm bilge separator, provision is to be made for a sampling arrangement as close as practicable to the 15 ppm bilge separator outlet. The sampling arrangement design is to be according to Fig. 2.9.6.

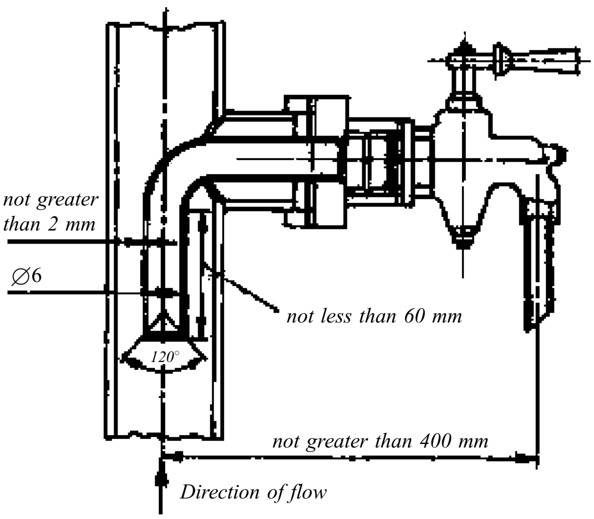


Fig. 2.9.6 Sampling arrangement for pressure piping

2.9.7 The 15 ppm bilge separator inlet pipelines are not to have connections with the pipelines of sea water or fresh water systems. The 15 ppm bilge separator pipelines may have connections with the above pipelines for washing purposes in accordance with the approved design of the 15 ppm bilge separator.

Table 2.9.8

Ship's gross tonnage	Recommended 15 ppm bilge separator throughput, in m^3/h
400 and above, but less than 1600	0,5
1600 and above, but less than 4000	1,0
4000 and above	2.5

2.9.8 The recommended throughput of 15 ppm bilge separators depending on the ship's gross tonnage is specified in Table 2.9.8.

2.10 15 PPM BILGE ALARM

2.10.1 A 15 ppm bilge alarm is to be of an approved type and its design is to comply with the provisions of Resolution MEPC.107(49) (taking into consideration the provisions of MEPC.1/Circ.643).

2.10.2 The 15 ppm bilge alarm is to resist corrosion in conditions of the marine environment. The 15 ppm bilge alarm is not to contain or use any substance of a dangerous nature, unless adequate arrangements, approved by the Register, are provided to eliminate any hazards introduced thereby.

2.10.3 The 15 ppm bilge alarm, if intended to be fitted in locations where flammable atmosphere may be present, is to comply with the requirements of Part IX "Electrical Equipment". Any moving parts of the 15 ppm bilge alarm fitted in hazardous areas are to be so designed as to avoid the formation of static electricity.

2.10.4 The 15 ppm bilge alarm is to be capable of reliable operation in climatic conditions and under mechanical effects in accordance with Part IX "Electrical Equipment".

2.10.5 The response time of the 15 ppm bilge alarm, that is, the time which elapses between an alteration in the sample being supplied to the 15 ppm bilge alarm and the ppm display showing the correct response, is not to exceed 5 s.

2.10.6 The 15 ppm bilge alarm is to be fitted with an electrical/electronic device which is to be pre-set by the manufacturer to activate when the effluent exceeds 15 ppm with a simultaneous provision of a command to the automatic stopping device to discontinue discharge overboard. This is also to operate automatically if at any time the 15 ppm bilge alarm fails to function, requires a warm-up period or otherwise is de-energized.

2.11 AUTOMATIC STOPPING DEVICE

2.11.1 The automatic stopping device is to stop any discharge overboard of oily mixture when the 15 ppm bilge alarm referred to in 2.10 activates.

2.11.2 The automatic stopping device is to consist of a valve arrangement installed in the effluent outlet line of the 15 ppm bilge separator, which automatically diverts the effluent mixture from being discharged overboard back to the ship's bilges or oil-containing bilge water holding tank when the oil content of the effluent exceeds 15 ppm.

2.12 OIL FUEL TANKS PROTECTION

2.12.1 Definitions and explanations.

Oil fuel tank is a tank in which oil fuel used in the main and auxiliary machinery is carried, except for overflow tanks.

Small oil fuel tank is an oil fuel tank with a maximum individual capacity not greater than 30 m^3.

Oil fuel capacity is the volume of a tank, in m^3, at 98 per cent filling.

Skeg is a structure of the ship's keel extending below the moulded line of the bottom shell plating.

2.12.2 Requirements.

2.12.2.1 For ships having an aggregate oil fuel capacity of 600 m^3 and above, oil fuel tanks are to be located above the moulded line of the bottom shell plating nowhere less than the distance *h* not less than 0,6 m. In the turn of the bilge area and at locations without clearly defined turn of the bilge, the oil fuel tank boundary line is to run parallel to the line of the midship flat bottom.

2.12.2.2 For ships having an aggregate oil fuel capacity of 600 m^3 and more, oil fuel tanks are to be located inboard of the moulded line of the side shell plating, nowhere less than the distance *w*, in m, which is measured at any cross-section at right angles to the side shell, as specified below:

$$w = 0{,}4 + 2{,}4C/20000 \tag{2.12.2.2}$$

where C = total volume of oil fuel including the volume of the small oil fuel tank, in m^3, at 98 per cent filling,

but not less than 0,6 m.

2.12.2.3 Provisions of 2.12.2.1 и 2.12.2.2 apply to all oil fuel tanks except small oil fuel tanks, provided the aggregate capacity of such tanks does not exceed 600 m^3.

2.12.2.4 Suction wells in oil fuel tanks are to be as small as practicable and their size is to be appropriate to the size of the suction pipe and the area covered. The distance between the well bottom and the bottom shall plating is to be not less than 0,5 m, provided the wells capacity does not exceed 0,03 m^3.

2.12.2.5 Lines of oil fuel piping located at a distance from the ship's bottom of less than *h*, as defined in 2.12.2.1, or from the ship's side less than w, as defined in paragraph 2.12.2.2, are to be fitted with valves or similar closing devices within or immediately adjacent to the oil fuel tank. These valves are to be capable of being brought into operation from a readily accessible enclosed space the location of which is accessible from the navigation bridge or propulsion machinery control position without traversing exposed freeboard or super-structure decks. The valves are to close in case of remote control system failure (fail in a closed position) and are to be kept closed in inland waterways at any time when the tank contains oil fuel except that they may be opened during oil fuel transfer operations.

2.12.2.6 Provisions of 2.12.2.4 as regards location of suction wells in oil fuel tanks may be similarly applied to the location of valves in pipelines of oil fuel tanks, namely, these valves may be located at a distance of not less than 0,5 m from the bottom shell plating (refer to Fig. 2.12.2.6).

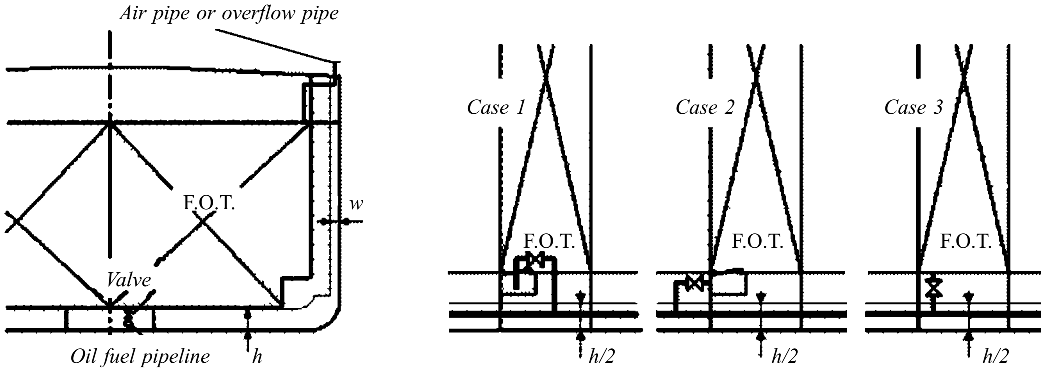


Fig. 2.12.2.6

Symbols:
h = the minimum distance of oil fuel tanks location from the moulded line of the bottom shell plating, in m;
w = the minimum distance of oil fuel tanks location from the moulded line of the side shell plating, in m;
F.O.T. = oil fuel tank.

2.12.2.7 Air or overflow pipes of oil fuel tanks are not to be considered as a part of oil fuel piping and therefore may be located at a distance of less than w from the side shell plating (refer to Fig, 2.12.2.6).

2.12.2.8 The distance *h* is to be measured from the moulded line of the bottom shell plating at right angles thereto.

2.12.2.9 For ships designed with a skeg, it is not to be considered as providing oil fuel tanks protection. For the area within the skeg breadth the distance *h* is to be measured at right angles to the line parallel to the base line, at the intersection of the skeg and the moulded line of the bottom shell plating as shown in Fig. 2.12.2.9.

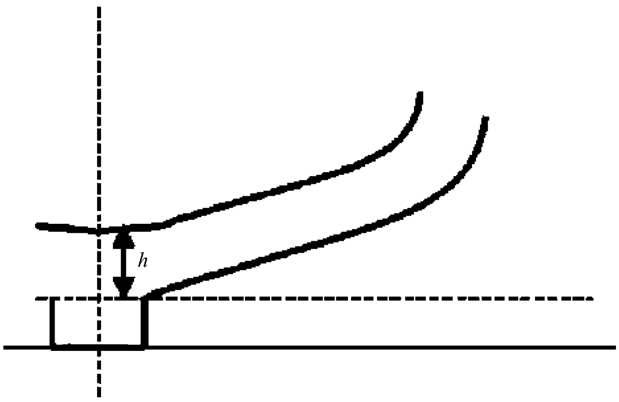


Fig. 2.12.2.9

2.12.2.10 For ships designed with constant trim, the base line is not to be used as a reference point. The distance *h* is to be measured at right angles to the moulded line of the bottom shell plating at the relevant frames where oil fuel tanks protection is to be provided.

2.12.2.11 For ships designed with the bottom rise, the distance 1,5*h* is to be measured from the moulded line of the bottom shell plating but at right angles to the base line, as shown in Fig. 2.12.2.11.

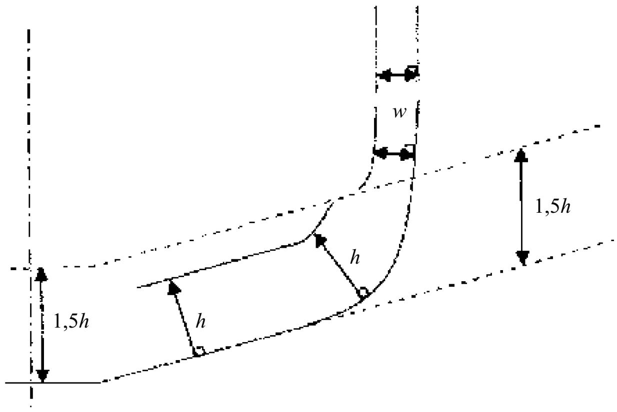


Fig. 2.12.2.11

3 SHIP'S EQUIPMENT AND ARRANGEMENTS FOR THE PREVENTION OF POLLUTION BY SEWAGE

3.1 DEFINITIONS AND EXPLANATIONS

3.1.1 In the present Section the following definitions have been adopted.

Holding tank is a tank for the collection and storage of untreated sewage and/or domestic waste water, activated sludge and pulp from the sewage and domestic waste water treatment plant.

Sewage:

drainage and other wastes from any form of toilets, urinals and WC scuppers;

drainage from wash basins, wash tubs and scuppers located in medical premises (dispensary, sick bay, etc.);

drainage from spaces containing living animals;

other waste waters when mixed with the drainage defined above.

Sewage treatment plant is a plant in which sewage and, if applicable, domestic waste water is treated and disinfected.

Domestic waste water:

drainage from wash basins, showers, laundries, wash tubs and scuppers;

drainage from sinks and equipment of galleys and other places annexed to galleys.

Number of persons on board is crew, passengers and special personnel, which the ship is certified to carry.

3.2 GENERAL

3.2.1 The ships listed in 1.3.1, Part I "Classification", with a permanent crew on board are to be provided with one of the following types of equipment:

.1 a holding tank (tanks) for untreated sewage and domestic waste water of sufficient capacity;

.2 a sewage and domestic waste water treatment plant of an approved type.

3.2.2 Pipelines, electrical equipment and control devices are to comply with the requirements of Part VII "Systems and Piping", Part IX "Electrical Equipment" and Part X "Automation".

3.3 HOLDING TANKS

3.3.1 The calculation, agreed with the customer, of the total capacity of sewage and domestic waste water holding tanks, with regard to the intended area of navigation, service conditions of the ship and number of persons on board, is to be submitted to the Register.

The volume of waste water holding tanks V_{ww} is to be calculated by the following formula:

$$V_{сб} = QNT \qquad (3.3.1)$$

where Q = sewage and domestic waste water discharge per person, in m^3/day, according to the norms established by the Flag Administration;
N = maximum admissible number of persons on board;
T = period between emptyings of the on-board tanks, in days.

When systems of sewage water vacuum transportation or other systems with reduced discharge of sewage water are used, the accumulation norms may be reduced.

3.3.2 Holding tanks may be built-in or independent.

3.3.3 Holding tanks are to be manufactured of steel. Tanks are to have smooth inner surfaces (except for built-in tanks), protected from contact with the medium and a bottom sloping towards the drain. Holding tanks are to be provided with manholes and with arrangements for flushing with water and for steaming. Arrangements for breaking up sediment are recommended.

3.3.4 Holding tanks are to be separated by cofferdams from the tanks used for drinking, washing and boiler water, as well as from accommodation, service (domestic) and cargo spaces. Holding tanks may be arranged without cofferdams if they are the ship's double hull compartments. Holding tanks may be located in separate spaces fitted with artificial exhaust ventilation.

3.3.5 Holding tanks must be fitted with a device which activates optical and acoustic signals in the wheelhouse or the central control station when the level of the liquid reaches 80 per cent of the tank capacity.

3.3.6 Holding tanks are to be tested by a test pressure equal to 1,5 times the water head pressure measured from the tank bottom to the lower toilet bowl not provided with a shut-off device at the discharge line, but not less than 25 kPa.

3.4 EQUIPMENT FOR SEWAGE AND DOMESTIC WASTE WATER DISCHARGE

3.4.1 In every ship provision is to be made (irrespective availability of sewage and domestic waste water treatment plant or sewage and domestic waste water holding tanks) for pipeline for discharge of sewage and domestic waste water to the reception facilities the discharge connections of which are to have flanges of standard dimensions in accordance with Fig. 3.4.1 or quick-release type connections conforming to the

EN 1305:1996 standard. The pipeline is to be led to both sides of the ship.

In well grounded cases, on agreement with the Register, the pipeline may be led to one side of the ship. Discharge manifolds are to be located in places convenient for connection of hoses and are to have nameplates. Discharge manifolds are to be provided with blank flanges.

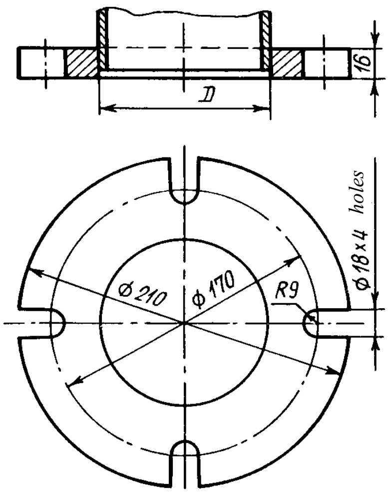


Fig. 3.4.1

Note. The flange is intended for pipes with an internal diameter of up to 100 mm and is to be manufactured from steel or an equivalent material with a flat machined surface. The flange, together with a gasket, must be designed for a working pressure of 0,6 MPa. For ships with moulded depth of 5 m or less the inner diameter of the discharge connection may be 38 mm. Coupling is effected by means of four 16 mm diameter bolts of requisite length.

3.4.2 Starting and stopping of the discharge arrangements is to be effected manually. In the vicinity of discharge manifolds provision is to be made for the discharge observation and remote cut-off position or the effective communication system (telephone or radio) between the observation position and the discharge control position.

3.4.3 The pipelines for discharge of sewage and domestic waste water to reception facilities are not to have connections with pipelines of other systems except for the pipeline specified in 3.4.4.

3.4.4 Provision is to be made for the sewage and domestic waste water discharge pipelines to be flushed by sea water. The washings are to be tapped either to the reception facilities or back to the holding tank.

3.4.5 Two pumps are to be provided to discharge sewage and domestic waste water from the holding tanks. One pump may be replaced by an ejector. On agreement with the Register, depending on the purpose of the ship and its service conditions the installation of one pump may be permitted.

3.4.6 On agreement with the Register, ships of less than 24 m in length may not be provided with discharge observation and remote cut-off position or the effective communication system between the observation position and the discharge control position. In all cases measures are to be provided to prevent possible discharge of these waters overboard.

3.4.7 Closing arrangements of discharge pipelines is to be capable of being sealed.

3.5 SEWAGE TREATMENT PLANTS

3.5.1 The capacity of the sewage treatment plant, in l/day, is to be determined by the following formula:

$$Q = nq \qquad (3.5.1)$$

where n = number of persons;
q = daily amount of sewage and, if applicable, of domestic waste water per one person, in l (according to the current standards).

3.5.2 Sewage treatment plants are to be of an approved type and provide the degree of cleaning in accordance with the current international standards[1].

The effluent is not to contain any visible floating solid particles or cause a colour change of the water around it.

3.5.3 Sewage treatment plants are to be tested for tightness according to 3.3.6. Pipelines are to be tested by a hydraulic test pressure p_{test} = 1,5p, where p is the working pressure.

3.5.4 Sewage treatment plants are to be tested at the manufacturer's or on board the ship according to the program approved by the Register.

3.5.5 Sewage treatment plants may be located in machinery spaces or in separate spaces with effective exhaust mechanical ventilation.

3.5.6 Effective means are to be provided for washing and disinfecting the sewage treatment plants, the associated machinery and piping in order to carry out the inspection or repair works.

3.5.7 A sewage treatment plant is to be fitted with a sampling device for purified and disinfected water.

3.5.8 The sewage pipelines between the scuppers of ship spaces and sewage treatment plants or holding tanks are to be provided with arrangements to prevent the smell of untreated sewage from getting into the ship's spaces.

[1] Refer to Technical Requirements for Sewage Treatment Plants adopted by Resolution IMO MEPC.2(VI). For ships the keel of which was laid on 01 January 2010 or after this date, the plants are to comply with the requirements of Resolution IMO MEPC.159(55). On existing ships, the provisions of MEPC.159(55) apply to new plants with the contract date of delivery 01 January 2010 or after this date, and if this date is unknown — to plants which are actually delivered to the ship on 01 January 2010 or after this date.

4 SHIP'S EQUIPMENT AND ARRANGEMENTS FOR THE PREVENTION OF POLLUTION BY GARBAGE

4.1 GENERAL

4.1.1 Each ship with a permanent crew is to be provided with special facilities for the prevention of pollution by garbage.

4.1.2 The garbage generated is to be collected and stored on board for discharge to reception facilities or for burning in the ship's incinerator (provided there are no restrictions imposed by the Administration).

4.2 DEFINITIONS AND EXPLANATIONS

4.2.1 In the present Section the following definitions have been adopted.

Garbage is all kinds of victual, domestic and operational waste (excluding fresh fish and parts thereof) generated during normal operation of the ship

Incinerator is the ship's plant for burning solid wastes generated during operation of the ship.

Garbage processing device is a device for reducing the garbage volume.

Garbage receptacle is containers and other receptacles for collection and storage of garbage.

Number of persons on board is crew, passengers and special personnel, which the ship is certified to carry.

4.3 EQUIPMENT AND DEVICES FOR GARBAGE COLLECTION, STORAGE AND PROCESSING

4.3.1 General.

4.3.1.1 Every ship is to be provided with garbage receptacles. Ships may be fitted with incinerators and garbage processing devices having regard to such factors as ship's type, area of navigation, number of crew, etc.

4.3.1.2 Garbage processing devices, incinerators and associated systems are to comply with the requirements of Part VII "Systems and Piping" and Part IX "Electrical Equipment", and the control, regulation and monitoring devices are to comply with the requirements of Part X "Automation".

4.3.2 Garbage receptacles.

4.3.2.1 Garbage receptacles are to be removable.

4.3.2.2 The calculation, agreed with the customer, of the total capacity of garbage receptacles having regard to the intended area of navigation, service conditions of the ship and number of persons on board, is to be submitted to the Register.

4.3.2.3 Garbage receptacles are to have smooth inner surfaces.

4.3.2.4 Garbage receptacles are to be provided with appliances for reliable securing on board the ship.

4.3.2.5 Garbage receptacles are to be provided with covers ensuring tight closure of openings for garbage loading.

4.3.2.6 Garbage receptacles are to be grouped into three categories:

receptacles for plastics;

receptacles for food waste;

receptacles for other garbage.

The garbage receptacles of all three categories are to be clearly marked and differ in colour.

4.3.2.7 Special receptacles are to be provided for collecting ashes containing residues of toxic substances or heavy metals from incinerators after burning plastics.

4.3.2.8 Garbage receptacles are to be located in places convenient for garbage discharge to reception facilities, transport to processing or incineration locations. Garbage receptacles may be placed on the weather deck or in ventilated spaces isolated from accommodation and service spaces. In all cases garbage is to be so stored as to avoid human health and safety hazards.

4.3.3 Garbage comminuters and compactors.

4.3.3.1 Garbage compactors are to be installed in a compartment with adequate room for operating and maintaining the unit and storing trash to be processed. The space is to have freshwater washdown service, coamings, deck drains, adequate ventilation and fire-fighting equipment.

4.3.3.2 Garbage comminuters and compactors are to be provided with nameplates containing instructions for their operation.

4.3.3.3 Garbage comminuters are to provide for comminution of particles not exceeding 25 mm in size.

4.3.4 Incinerators.

4.3.4.1 The incinerator installed on board the ship on or after 1 January 2000 is to comply with the requirements of Resolution MEPC.76(40) and is to be approved by the Register on behalf of the Administration considering the standard requirements to ship's incinerators according to this Resolution.

4.3.4.2 Where fuel oil and oil residues leakage is likely to occur trays are to be fitted which are to be efficiently drained. The leaked fuel oil and oil residues collected in the trays are to be tapped to the oil leakage collecting pipeline.

4.3.4.3 The exhaust gas system, fuel oil and oil residues pipelines, fittings, mechanical and flexible metal couplings of incinerators are to comply with the requirements of Part VII "Systems and Piping".

4.3.4.4 Oil residues incinerators are to be equipped with oil residues processing system.

4.3.4.5 The oil residues processing system is to comply with 2.8.3 to 2.8.5.

4.3.4.6 Incinerators may be located in machinery spaces or in separate spaces.

4.3.4.7 The system of the fuel oil supply to the burners is to be so designed that they can be shut down from two positions, one of which is to be outside the space in which the incinerator is installed.

4.3.4.8 Where the incinerator is located in a separate space, provision is to be made for the following:

.1 supply and exhaust ventilation ensuring sufficient airflow necessary for operation of the incinerator;

.2 automatic fire alarm and detection systems in compliance with Part V "Fire Protection";

.3 fire extinguishing system in compliance with Part V "Fire Protection".

5 SHIP'S CONSTRUCTION, EQUIPMENT AND ARRANGEMENTS FOR THE PREVENTION OF POLLUTION BY NOXIOUS LIQUID SUBSTANCES IN BULK

5.1 GENERAL

5.1.1 The construction, equipment and arrangements of ships carrying noxious liquid substances in bulk depending on the denomination of the carried cargo, and of ships carrying vegetable oils in bulk, specified in Part XI "Summary of Technical Requirements" of Rules for the Classification and Construction of Chemical Tankers are to comply with the provisions of ADN Rules and Rules for the Classification and Construction of Chemical Tankers, whichever is applicable.

6 SHIP'S EQUIPMENT AND ARRANGEMENTS FOR THE PREVENTION OF AIR POLLUTION

6.1 GENERAL

6.1.1 The provisions of the present Section, unless provided otherwise, apply to ships specified in 1.3.1, Part I "Classification".

6.2 DEFINITIONS AND EXPLANATIONS

6.2.1 In the present Section the following definitions have been adopted.

Parent marine diesel engine for determining the emissions is the marine diesel engine with a set of similar features specific within the family or the group and having the largest emissions.

Emission is release to the atmosphere of combustion products together with the exhaust gases such as carbon oxides (CO), hydrocarbons (HC), nitrogen oxides (NO_x), and particulates (PT).

Test cycle is aggregate, measured power at the test diesel engine speed set as per diesel engine application and realized in tests for the calculation of average weighted emission.

Rated power is the maximum continuous rated power output, as specified on the nameplate and in the Technical File of Marine Diesel Engine.

Rated speed is the crankshaft revolutions per minute, at which the rated power occurs, as specified on the nameplate and in the Technical File of Marine Diesel Engine.

Exhaust gases (EG) are mixture of products of combustion of fuel, excess air and various micro impurities (both gaseous and liquid, or solid particulates) emitted from diesel engine cylinders to its intake system and further to the atmosphere.

Marine diesel engine is any reciprocating internal combustion diesel engine operating on liquid or dual fuel (as per gas-diesel cycle), including booster/ compound system if applied.

Cargo vapour collection system is an arrangement consisting of pipelines and hoses applied for collecting vapours from cargo tanks of tankers and their transfer to the device intended for their processing (i.e., utilization, for example, by means of burning).

Shipboard incineration is the incineration of wastes or other matter on board a ship, if such wastes or other matter were generated during the normal operation of that ship.

Engine type is a batch of engines which are identical in terms of the essential features of the engine; at least one unit of the engine type is to be constructed.

Technical File of Marine Diesel Engine is a record containing all details of parameters, including components and settings of an engine, which may influence the emissions of the engine.

Engine Parameter Protocol is the document for recording all parameter changes, including components and engine settings which affect the level of emission from the engine. The Protocol is to contain records on any changes affecting the set engine parameters, including engine settings, change and modification of engine components.

6.3 EXHAUST GASES EMISSION STANDARDS FOR MARINE DIESEL ENGINES

6.3.1 The provisions of the present Chapter are to apply to all main and auxiliary marine diesel engines of a rated power greater than 19 kW installed on board ships or in machinery on board such ships.

6.3.2 The above engines are to comply with the requirements of Directive 97/68/EC "Measures Against the Emission of Gaseous and Particulate Pollutants from Internal Combustion Engines to be Installed in Non-Road Mobile Machinery", as amended, depending on rated power, date of installation on board, swept volume per cylinder in litres.

6.3.3 When applying the requirements of the present Chapter to ships in service having the valid Ship's Certificate at 30 December 2008, the provisions of Chapter 24 and Chapter 24a of Directive 97/68/EC, as amended by Directive 2009/46/EC are to be considered.

6.3.4 The engines referred to in 6.3.1 apply, are to be initially tested at the manufacturer. Bench tests are carried out either for parent engine or for each separate engine by using the ISO test procedure as specified in ISO 8178-4:2002 and NO_x Technical Code (Annex VI to MARPOL 73/78).

6.3.5 After the installation of the engine on board, but before it is brought into service, an installation check is to be made by the parameters check method or by other approved methods in compliance with ISO 8178-2:1996 (GOST P 52408-2005) standard. This check, which is part of the initial survey of the ship or of a periodical survey justified by the installation of the engine in question, leads either to the registration of the engine in the first Ship's Certificate drawn up or to an amendment to the existing Ship's Certificate.

6.3.6 The Technical File of Marine Diesel Engine with the procedure for survey of the engine on board the ship compiled by the manufacturer and an Engine Parameter Protocol are to be on board.

6.3.7 After each change in the engine having the potential to affect the emission, the special tests are to be carried out confirming that notwithstanding changes the emission level complies with the requirements of the present Chapter.

6.4 PREVENTION OF USE OF OZONE DEPLETING SUBSTANCES

6.4.1 Scope of application

The requirements of the present Chapter apply to new installations fitted on ships after 19 May 2005.

6.4.2 Definitions and explanations

In the present Chapter the following definitions have been adopted.

New installations are the installation of systems, equipment, including new portable fire extinguishing units, insulation, or other material on a ship after 19 May 2005, but excludes repair or recharge of previously installed systems, equipment, insulation, or other material, or recharge of portable fire extinguishing units.

Ozone depleting substances are controlled substances defined in paragraph 4 of article I of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the said Protocol in force at the time of application or Interpretation of Annex VI to MARPOL 73/78/97.

6.4.3 Installations and prevention of emissions

6.4.3.1 New installations which contain ozone depleting substances are to be prohibited on all ships, except new installations containing hydro-chlorofluorocarbons (HCFCs) which are permitted until 1 January 2020.

Ozone depleting substances that may be found on board ship include, but are not limited to:

Group I: **CFC-11** (trichlorofluoromethane, $CFCl_3$);

CFC-12 (dichlorodifluoromethane, CF_2Cl_2);

CFC-113 (1,1,2-trichloro- 1,2,2-trifluoroethane, C2F3Cl3);

CFC-114 (1,2 -dichloro-1,1,2,2-tetrafluoroethane, $C_2F_4Cl_2$);

CFC-115 (chloropentafluoroethane, C_2F_5Cl);

Group II: **Halon 1211** (bromochlorodifluoromethane, CF_2BrCl);

Halon 1301 (bromotrifluoromethane, CF_3Br);

Halon 2402 (1,2 dibromo-1,1,2,2-tetrafluoroethane, $C_2F_4Br_2$), also known as Halon 114B2.

6.4.3.2 Any deliberate emissions of ozone depleting substances are to be prohibited. Deliberate emissions include emissions occurring in the course of maintaining, servicing, repairing or disposing of systems or equipment, except that deliberate emissions do not include minimal releases associated with the recapture or recycling of an ozone depleting substance.

6.4.3.3 Ozone depleting substances referred to in 6.4.3.1, and equipment containing such substances, are to be delivered to appropriate reception facilities when removed from ships.

6.5 SULFUR CONTENT IN SHIP'S FUEL

6.5.1 The sulfur content of any fuel oil used on board ships navigating in the EC territorial waters including inland waterways and ports is to be in compliance with the requirements of the corresponding Directive 2005/33/EC of the European Parliament and of the Council with subsequent annexes.

6.5.2 The information about fuel oil delivered to and used on board ship is to be recorded by means of a bunker delivery notes to be accompanied by a representative sample of the fuel oil taken from the fuel oil receiving collector of the ship by an approved method by means of a sampling device in accordance with Resolution MEPC.96(47).

6.5.3 The ship's fuel oil system is to ensure a safe fuel-changeover to the fuel with the required sulfur content prior to entering SO_x Emission Control Areas.

6.5.4 Alternatively, an exhaust gas cleaning system, approved by the Administration, taking into account the provisions of Regulation EC No.2099/2002, may be used on ships for reducing the total emission of sulfur oxides from both auxiliary and main propulsion engines to the limits equivalent to the sulfur content in the ship's oil fuel as specified in 6.5.1.

6.6 VOLATILE ORGANIC COMPOUNDS

6.6.1 All tankers which are subject to volatile organic compounds vapour emission control are to be provided with a vapour collection system approved by the Register in accordance with Part VII "Systems and Piping".

6.7 SHIPBOARD INCINERATION

6.7.1 Shipboard incineration is to be allowed only in a shipboard incinerator of an approved design in accordance with 4.3.4.

The incineration of oil residues is allowed only in the following approved installations:

.1 incinerators with appropriate oil residues processing systems;

.2 auxiliary steam boilers with appropriate oil residues processing systems;

.3 heaters of thermal liquid systems with appropriate oil residues processing systems;

.4 inert gas systems with appropriate oil residues processing systems.

PART XIV. REQUIREMENTS FOR SHIPS CARRYING DANGEROUS GOODS

1 GENERAL

1.1 APPLICATION

1.1.1 The requirements of the present Part refer to ships carrying dangerous goods.

1.1.2 The present Part establishes special additional requirements for ships to be complied with during carriage of dangerous goods in bulk on dry cargo ships and oil tankers.

1.1.3 The requirements of the present Part do not apply to ship stores. Requirements for ship stores in respect of storage of flammable liquids, compressed air cylinders etc. are set forth in relevant parts of the present Rules.

1.2 DEFINITIONS

1.2.1 The following definitions have been adopted in the present Part.

ADN means European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterway as adopted by the Diplomatic Conference on 25 May 2000, Geneva.

Cargo pump room — refer to definition in 1.1.1.4, Part II "Hull".

Cargo tank — refer to definitions in 1.1.1.4, Part II "Hull".

Accommodation spaces are the premises intended for the use of persons normally living on board, including galleys, food stores, lavatories, washrooms, bathrooms, laundries, alleyways, but excluding wheelhouse.

Protected area means:

the hold or holds (when anti-explosion protection is required, comparable to zone 1);

the space situated above the deck (when anti-explosion protection is required, comparable to zone 2) bounded:

athwart ships, by vertical planes corresponding to side plating;

fore and aft, by vertical planes corresponding to end bulkheads of the hold;

upwards, by horizontal plane 2 m above the upper level of the load, but at least by a horizontal plane 3 m above the deck.

Flammable gas detector means a device allowing measuring of any significant concentration of flammable gases given off by the cargo below the lowest explosive limit and which clearly indicates the presence of higher concentrations of such gases. Flammable gas detectors may be designed for measuring flammable gases only but also for measuring both flammable gases and oxygen. This device shall be designed so that measurements are possible without the necessity of entering the spaces to be checked.

Oxygen meter means a device allowing measuring of any significant reduction of oxygen content in the air. Oxygen meters may either be a device for measuring oxygen only or part of a combination device for measuring both flammable gas and oxygen. This device shall be so designed that measurements are possible without the necessity of entering the spaces to be checked.

Cofferdam — refer to definition in 1.1.1.4, Part II "Hull".

Tanker — refer to definition in 1.1.2, Part I "Classification".

Naked light means a source of light using a flame which is not enclosed in a flameproof enclosure.

Dangerous goods mean substances and articles the carriage of which is prohibited by ADN or authorized only under the conditions prescribed by ADN. The list of dangerous goods is set forth in Chapter 3.2 "List of Dangerous Goods" of ADN Regulations including: in numerical order — in Table A, in alphabetical order — in Table B and those accepted for carriage in tank ships in numerical order — in Table C.

Residual cargo is liquid cargo remaining in the cargo tank or cargo piping after unloading without the use of the stripping system.

Slops are liquid cargo residues which cannot be removed from the cargo tank or cargo piping by discharging, draining or stripping; by extension, a mixture of cargo residues and washing water, rust, etc., which is either suitable or not suitable for piping.

Bulkhead means a metal, generally vertical wall inside the ship and which is bounded by the bottom, the side plating, a deck, hatchway covers or by another bulkhead.

Bulkhead (water and gastight):

in a tank ship means a bulkhead constructed to withstand a water pressure of 1 m above the deck;

in a dry cargo ship means a bulkhead constructed so that it can withstand water pressure with a head of 1 m above the deck, but at least to the top of the hatchway coaming.

ADN Regulations mean the Regulations enclosed to ADN.

Service space – refer to definition in 1.1.1.4, Part II "Hull".

Breathing apparatus (ambient air-dependent) means an apparatus which protects the person wearing it when working in a dangerous atmosphere by means of a suitable fiter.

Oil separator vessel means an open type **N** tank ship with a dead weight of up to 300 t, constructed and fitted to accept and carry oily and greasy wastes from the operation of ships.

Supply vessel means an open type **N** tank ship with a dead weight of up to 300 t constructed and fitted for the carriage and delivery to other ships of products intended for the operation of ships.

Types of ships: **G** type, **C** type and **N** type — refer to definition in 1.1.2, Part I "Classification".

Noxious gas meter means a device enabling to measure any significant concentration of noxious gases emitted by cargo. Such device shall be designed so that measurement could be performed without entry into space liable to measurement.

Hold — refer to definition in 1.1.1.4, Part II "Hull".

Hold space — refer to definition in 1.1.1.4, Part II "Hull".

Other definitions referring to ADN Regulations are given in Chapter 1.2 "Definitions and Units of Measurement", Part 1, ADN Regulations.

1.3 SCOPE OF TECHNICAL SUPERVISION

1.3.1 General provisions referring to the procedure of classification, technical supervision of construction, classification surveys as well as the scope of technical documentation submitted to the Register for review and approval are set forth in General Regulations for the Classification and Other Activity and Part I "Classification" of the present Rules.

1.3.2 Structure, equipment and ship stores ensuring safe carriage of dangerous goods within the scope of requirements set forth in the present Part are liable to technical supervision by the Register.

1.3.3 When the ship is allowed to carry dangerous goods the documents listed in 8.1.2.1 d), e), f), g) and h) of Section 8.1 "General Requirements Applicable to Vessels and Equipment" of Part 8, ADN Regulations are to be submitted to the Register as well as those additionally provided in 8.1.2.2 b) and c) for dry cargo ships and 8.1.2.3 a), b), c), d), e), f), h), i), j), k) and l) for tankers. Damage Control Plan and intact stability documents are to be submitted to the Register for approval as well as all conditions of intact stability of ship taken into consideration during calculation of stability.

Documents are to be submitted in language comprehendible by ship crew and be translated into English.

2 REQUIREMENTS FOR STRUCTURE, EQUIPMENT AND SUPPLY OF SHIPS CARRYING DANGEROUS GOODS

2.1 REQUIREMENTS FOR DRY CARGO SHIPS CARRYING PACKAGED DANGEROUS GOODS OR DANGEROUS GOODS IN BULK AND NOT COMPLYING WITH THE REQUIREMENTS OF SECTION 7, PART VI "FIRE PROTECTION" OF RULES FOR THE CLASSIFIICATION AND CONSTRUCTION OF SEA-GOING SHIPS

2.1.1 The ship's hull is to be constructed of shipbuilding steel or other metal, provided that this metal has at least equivalent mechanical properties and resistance to the effects of temperature and fire.

2.1.2 Cargo holds are to comply with the following requirements:

.1 each hold is to be bounded fore and aft by watertight metal bulkheads;

.2 the holds are to have no common bulkhead with the oil fuel tanks;

.3 the bottom of the holds is to be such as to permit them to be cleaned and dried;

.4 the hatchway covers are to be spraytight and weathertight and comply with requirements of 9.5, Part III "Equipment, Arranqements and Outfit" or be covered by waterproof tarpaulins. Tarpaulins used to cover the holds are not to readily ignite;

.5 no heating appliances are to be installed in the holds.

2.1.3 Ventilation of cargo holds is to comply with requirements of 11.6, Part VII "Systems and Piping". Ventilation of cargo holds is needed if this is required by 7.1.6.12, ADN Regulations or additional prescription "VE..." in column 10, Table A, Chapter 3.2, ADN Regulations.

2.1.4 Accommodation spaces and service spaces are to comply with requirements of 13.1.1, Part III "Equipment, Arrangements and Outfit".

2.1.5 The double-hull spaces and double bottoms may be arranged for being filled with water ballast.

2.1.6 Engines are to comply with requirements of 1.1.2, Part VI "Machinery Installations".

2.1.7 Ventilation openings of engine rooms and air intakes of engines are to comply with requirements of 11.1 and 11.4, Part VII "Systems and Piping".

2.1.8 Sparking is to be precluded in the protected area.

2.1.9 Fuel oil tanks are to comply with requirements of 4.3, Part VI "Machinery Installations" and 12.7, Part VII "Systems and Piping".

2.1.10 Engine exhaust pipes are to be provided with spark arresters and shall comply with requirements of Section 10, Part VII "Systems and Piping".

The exhaust outlets are to be located not less than 2 m from the hatchway openings.

2.1.11 Cargo hold bilge system is to comply with the requirements of 6.11, Part VII "Systems and Piping".

2.1.12 Water fire main system is to comply with the requirements of 4.3.7, Part V "Fire Protection".

2.1.13 A single fire or ballast pump is to suffice on board pushed barges without their own means of propulsion.

2.1.14 Engine room is to be provided with a permanently fixed gas fire extinguishing system complying with the requirements of 4.7, Part V "Fire Protection".

2.1.15 Ventilation of engine rooms protected by permanently fixed gas fire extinguishing systems is to comply with requirements of 11.4.5, Part VII "Systems and Piping".

2.1.16 The space to be protected by permanently fixed gas fireextinquishing systems are to be monitored by an appropriate fire alarm system. The alarm signal is to be audible in the wheelhouse, the accommodation and the space to be protected.

2.1.17 Spaces protected by permanently fixed gas fireextinguishing systems are to be equipped with the fire warning alarms complying with requirements of 5.17, Part V "Fire Protection".

2.1.18 The outlets of funnels are to be located not less than 2 m from the hatchway openings. Arrangements are to be provided to prevent the escape of sparks and the entry of water.

2.1.19 Heating, cooking and refrigerating appliances are not to be fuelled with liquid fuels, liquid gas or solid fuels. The installation in the engine room or other separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55 °C is, however, permitted. Cooking and refrigerating appliances are permitted only in wheelhouses with metal floor and in the accommodation.

Electric lighting appliances only are permitted outside the accomodation and the wheelhouse.

2.1.20 It is to be possible to isolate the electrical equipment in the protected area by means of centrally located switches except cases when the electrical equipment complies with the requirements of 2.9, Part IX "Electrical Equipment".

2.1.21 Accumulators are to be located outside the protected area.

2.1.22 Ventilators of cargo holds are to comply with requirements of 11.6.4, Part VII "Systems and Piping".

2.1.23 Electrical cables and sockets located in the protected zone are to comply with the requirements of 2.9.7 to 2.9.12, Part IX "Electrical Equipment".

2.1.24 All metal wires passing over the cargo holds and all masts are to be earthed, unless they are electrically bonded to the metal hull of the ship through their installation.

2.1.25 The notice boards displaying the prohibition of admittance are to be clearly legible from either side of the ship.

2.1.26 The notice boards displaying the prohibition of smoking are to be clearly legible from either side of the ship.

2.1.27 Notice boards indicating the circumstances under which the prohibition applies are to be fitted near the entrances to the spaces where smoking or the use of fire or naked light is not always prohibited.

2.1.28 Ashtrays are to be provided close to each exit of the accommodation and the wheelhouse.

2.1.29 Double-hull ships intended to carry dangerous goods of Classes 2, 3, 4.1, 4.2, 4.3, 4.3, 5.1, 5.2, 6.1, 7, 8 or 9, except those for which danger label No. 1 is specified in column 5, Table A, Chapter 3.2, ADN Regulations, in quantities exceeding those referred to in 7.1.4.1.1, ADN Regulations are to comply with the requirements of 2.9, Part II "Hull", 13.1.1.4, Part III "Equipment, Arrangements and Outfit" and 3.3.8, Part IV "Stability, Subdivision and Freeboard".

2.2 REQUIREMENTS FOR DRY CARGO SHIPS CARRYING PACKAGED DANGEROUS GOODS OR DANGEROUS GOODS IN BULK AND COMPLYING WITH THE REQUIREMENTS OF SECTION 7, PART VI "FIRE PROTECTION" OF RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SEA-GOING SHIPS

2.2.1 Ships are to comply with the requirements of 2.1.1, 2.1.5, 2.1.7, 2.1.8, 2.1.10, 2.1.18, 2.1.19, 2.1.24 to 2.1.29.

2.2.2 Only internal combustion engines running on a fuel having a flashpoint above 60 °C, are allowed.

2.2.3 Double-hull ships intended to carry dangerous goods of Classes 2, 3, 4.1, 4.2, 4.3, 4.3, 5.1, 5.2, 6.1, 7, 8 or 9, except those for which danger label No. 1 is specified in column 5, Table A, Chapter 3.2, ADN Regulations, in quantities exceeding those referred to in 7.1.4.1.1, ADN Regulations are to comply with the requirements of 2.9, Part II "Hull", 13.1.1.4, Part III "Equipment, Arrangements and Outfit" and 3.3.8, Part IV "Stability, Subdivision and Freeboard".

2.3 REQUIREMENTS FOR TANKERS OF TYPE G

2.3.1 The shipl's hull and the cargo tanks are to be constructed of shipbuilding steel or other at least equivalent metal.

The independent cargo tanks may also be constructed of other materials, provided these have at least equivalent mechanical properties and resistance against the effects of temperature and fire.

2.3.2 Every part of the ship including any installation and equipment which may come into contact with the cargo is to consist of materials which can neither be dangerously affected by the cargo nor cause decomposition of the cargo or react with it so as to form harmful or hazardous products.

2.3.3 It is prohibited to use wood, aluminium alloys or plastic materials except where explicitly permitted in 2.3.4 below within cargo spaces.

2.3.4 The use of wood, aluminium alloys or plastic materials within cargo area is only permitted for:

products listed in 13.2.1, Part III "Equipment, Arrangements and Outfit";

movable items of equipment;

chocking of cargo tanks which are independent of the ship's hull and chocking for installations and equipment;

engine parts;

parts of the electrical installation;

lids of boxes which are placed on the deck.

The use of wood or plastic materials within the cargo area is only permitted for supports and stops of any kind.

The use of plastic materials or rubber within the cargo area is only permitted for:

products listed in 13.2.1, Part III "Equipment, Arrangements and Outfit";

electric cables;

hoses for loading and unloading;

insulation of cargo tanks and of hoses for loading and unloading.

2.3.5 All permanently fitted materials in the accommodation or wheelhouse, with the exception of furniture, are not to readily ignite. They are not to evolve fumes or toxic gases in dangerous quantities, if involved in a fire (refer to 1.6, Part VI "Fire Protection" of Rules for the Classification and Construction of Sea-Going Ships).

2.3.6 The paint used in the cargo area is not to be liable to produce sparks in case of impact.

2.3.7 Ship lifeboats are to comply with the requirements of 13.2.2, Part III "Equipment, Arrangements and Outfit".

2.3.8 The ship is to be designed so as to prevent gases from penetrating into the accommodation and the service spaces.

2.3.9 Requirements of 13.2.2 to 13.2.5, Part III "Equipment, Arrangements and Outfit" are to be complied with in respect of protection against penetration of gases into accommodation and service spaces.

2.3.10 Cargo tanks are to comply with the requirements of 3.1.2.1, Part II "Hull".

2.3.11 Within cargo area hull is to be designed in compliance with the requirements of 3.1, Part II "Hull".

2.3.12 The hold spaces are to be separated from the accommodation and service spaces outside the cargo area below deck by "A-60" class bulkheads.

All spaces in the cargo area are to be capable of being ventilated. Means for checking their gas-free condition are to be provided.

2.3.13 The bulkheads bounding the hold spaces are to comply with requirements of 13.2.5, Part III "Equipment, Arrangements and Outfit".

2.3.14 Double-hull spaces and double bottoms in the cargo area are to be arranged for being filled with ballast water only. Double bottoms may, however, be used as oil fuel tanks, provided they comply with the requirements of 2.3.31.

2.3.15 A space in the cargo area below deck may be arranged as a service space provided it is to comply with the requirements of 13.2.6 and 13.2.7, Part III "Equipment, Arrangements and Outfit".

2.3.16 Pipes for loading and unloading may be fitted in the cargo pump rooms below deck only if the requirements of 2.3.23 are complied with.

2.3.17 Hold spaces and other accessible spaces within the cargo area are to comply with the requirements of 13.2.8, Part III "Equipment, Arrangements and Outfit".

2.3.18 Ventilation system is to comply with the requirements of 9.7 and 11.6, Part VII "Systems and Piping".

2.3.19 Ship stability is to comply with the requirements of 3.3.8, Part IV "Stability, Subdivision and Freeboard".

2.3.20 Engine rooms is to comply with the requirements of 4.2.6 and 4.5.9, Part VI "Machinery Installations".

2.3.21 Accommodation and service spaces, wheelhouse are to comply with the requirements of 13.2.9 to 13.2.12, Part III "Equipment, Arrangements and Outfit".

2.3.22 Penetrations through the bulkheads are to comply with the following requirements:

.1 driving shafts of the bilge and ballast pumps within cargo area may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 2.3.15. The penetration of the shaft through the bulkhead is to be gastight and is to be approved by the Register. The necessary operating instructions shall be displayed;

.2 penetrations through the bulkhead between the engine room and the service space in the cargo area, and the bulkhead between the engine room and the hold spaces may be provided for the electric cables, hydraulic lines and piping for control for measuring control and alarm systems, provided that penetrations are gastight. Penetrations through "A-60" bulkhead are to have equivalent fire protection;

.3 pipes may pass through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the machinery in the engine room and the service space which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room;

.4 irrespective of requirements of 2.3.22.3 the pipelines from the engine room may pass through the service space in the cargo area, cofferdam, hold or double side if they are thick and have neither flanges nor openings within this service space;

.5 where a driving shaft of auxiliary machinery penetrates through a bulkhead located above the deck the penetration is to be gastight.

2.3.23 A service space located the cargo area below deck is not to be used as cargo pump room except where:

.1 the pump room is separated from the engine room or from service spaces outside the cargo area by a cofferdam a bulkhead with an "A-60" fire protection insulation;

.2 the "A-60" bulkhead required above doesn't include penetrations referred to in 2.3.22.1;

.3 ventilation exhaust outlets are located not less than 6 m from entrances and openings of the accommodation and service spaces;

.4 the access hatches and ventilation inlets can be closed from outside;

.5 all pipes for loading and unloading are to be laid on open deck above the pump room. The necessary cargo operations, starting and stopping pumps or compressors are to be effected from upper deck;

.6 there is to be atmosphere control system complying with the requirements of 9.14, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships installed in cargo pump room;

.7 ventilation system is to comply with requirements of 9.7.3, Part VII "Systems and Piping" at a capacity of at least 30 air changes per hour.

2.3.24 The following instruction is to be displayed at the entrance of the cargo pump room: "Before entering the cargo pump room check whether it is free from gases and contains sufficient oxygen. Do not open doors and entrance openings without the permission of the master. Leave immediately in the event of alarm".

2.3.25 There is to be an inert gas system onboard complying with the requirements of 3.5, Part V "Fire Protection" of Rules for the Classification and Construction of Gas Carriers.

2.3.26 Cargo tanks are to be fitted with the instruments according to the requirements of Part VIII "Instrumentation" of Rules for the Classification and Construction of Gas Carriers.

2.3.27 Cargo tanks openings and cargo pipes are to be located within cargo area and be fitted with shut-off fittings tailored for the test pressure of cargo tank. Test pressure of cargo tanks are to be assigned in accordance with requirements of Section 11, Part IV "Cargo Tanks" of Rules for the Classification and Construction of Gas

Carriers. Pipelines of cargo and gas exhaust systems are to be within cargo area and comply with requirements of Part VI "Systems and Piping" of Rules for the Classification and Construction of Gas Carriers.

2.3.28 In cases specified in column 9, Table C, Chapter 3.2, ADN Regulations the ships are to be equipped with two independent refrigerant equipments complying with requirements of Section 4, Part VI "Systems and Piping" of Rules for the Classification and Construction of Gas Carriers.

2.3.29 When water-spray system is required in column 9, Table C, Chapter 3.2, ADN Regulations a water-spray system is to be installed whithin the cargo area on deck intended for spraying of the whole cargo area surface by water. The spray-nozzles are to be installed so that to cover the whole area of cargo deck.

Such system is to be equipped with a connection device to feed it from shore.

The system is to be operated from wheelhouse or from deck.

The outflow of water is to be supplied through spray-nozzles at least 50 l per 1 m^2 of cargo deck per hour.

2.3.30 Engines are to comply with the requirements of 1.1.2 and 4.6.3, Part VI "Machinery Installations" as well as 10.2.1, Part VII "Systems and Piping".

2.3.31 Fuel oil tanks are to comply with requirements of 4.3, Part VI "Machinery Installations" and 12.7, Part VII "Systems and Piping".

2.3.32 Engine exhaust pipes are to be fitted with spark arresters and they are to comply with requirements of Section 10, Part VII "Systems and Piping".

2.3.33 Water fire main system is to comply with the requirements of 4.3.7, Part V "Fire Protection".

2.3.34 The engine room, the cargo pump room and all spaces containing special equipment (switchboards, compressors etc.) for the refrigerant equipment, if any, are to be equipped with permanently fixed gas fire extinguishing system complying with requirements of 4.7, Part V "Fire Protection".

2.3.35 Ventilation of engine rooms protected by permanently fixed gas fire extinguishing systems is to comply with requirements of 11.4.6, Part VII "Systems and Piping".

2.3.36 The space to be protected by permanently fixed gas fire extinguishing system is to be monitored by an appropriate fire alarm system. The alarm signal is to be audible in the wheelhouse, the accommodation and the space to be protected.

2.3.37 Spaces to be protected by permanently fixed gas fire extinguishing systems are to be equipped with the fire warning alarms complying with requirements of 5.17, Part V "Fire Protection".

2.3.38 The outlets of funnels are to be located not less than 2 m from the hatchway openings. Arrangements are to be provided to prevent the escape of sparks and the entry of water.

2.3.39 Heating, cooking and refrigerating appliances are not to be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or other separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55 °C is, however, permitted. Cooking and refrigerating appliances are permitted only in wheel-houses with metal floor and in the accommodation.

Electric lighting appliances only are permitted outside the accomodation and the wheelhouse.

2.3.40 Electrical equipment is to comply with requirements of 19.2, Part IX "Electrical Equipment".

2.3.41 In cargo space metal parts of electrical equipment are to be earthed according to the requirements of 2.5, Part IX "Electrical Equipment".

Independent tanks are to be earthed to hull.

There is to be capability for earthing to hull of metal containers and tank containers used as tanks for cargo residues or slop tank.

2.3.42 Electrical cables and sockets located in the protected area are to comply with the requirements of 2.9.12 to 2.9.17, Part IX Electrical Equipment".

2.3.43 Shower and sink in a place directly accessible from cargo space are to be fitted onboard.

2.3.44 The notice boards displaying the prohibition of admittance are to be clearly legible from either side of the ship.

2.3.45 The notice boards displaying the prohibition of smoking are to be clearly legible from either side of the ship.

2.3.46 Notice boards indicating the circumstances under which the prohibition is applicable are to be fitted near the entrances to the spaces where smoking or the use of fire or naked light is not always prohibited.

2.3.47 Ashtrays are to be provided close to each exit of the accommodation and the deckhouse.

2.3.48 Emergency exit from spaces is to be provided according to the requirements of 13.2.13, Part III "Equipment, Arrangements and Outfit".

2.4 REQUIREMENTS FOR TANKERS OF TYPE C

2.4.1 Tankers of type **C** are to comply with the requirements of 2.3.1 to 2.3.12, 2.3.14, 2.3.16 to 2.3.18, 2.3.20 to 2.3.25, 2.3.29 to 2.3.48.

2.4.2 Cargo tanks are to comply with the requirements of 3.1, Part II "Hull".

2.4.3 Within cargo area the ship is to be designed in accordance with the requirements of 3.1.3, Part II "Hull".

2.4.4 There are to be facilities for ventilation of all spaces located within the cargo area. Detection of gas or vapours of transported cargo is in accordance with 9.14.1 and 9.14.2, Part VIII "Systems and Piping" of Rules for the Classification and Construction of Sea-Going Ships.

2.4.5 Bulkheads bounding cargo tanks, cofferdams and holds are to comply with the requirements of 13.3.2, Part III "Equipment, Arrangements and Outfit".

2.4.6 Cofferdam, the central part of cofferdam or other space below deck within cargo area may be equipped as service space if they comply with the requirements of 13.3.3, Part III "Equipment, Arrangements and Outfit".

2.4.7 There is to be facility for filling cofferdams with water and drying them by means of a pump which is required by 13.3.3, Part III "Equipment, Arrangements and Outfit". Filling is to take not more than 30 min. This requirement is not applicable if a bulkhead between engine room and cofferdam is "A-60" fire protected or when a cofferdam is equipped as a service space. Cofferdams are to have no charging valve.

It is not allowed to connect cofferdam with other ship pipelines outside cargo area by permanent pipe.

Ventilation openings are to be fitted with flame arresters.

2.4.8 Ship stability is to comply with requirements of 3.3.8, Part IV "Stability, Subdivision and Freeboard".

2.4.9 Cargo tanks are to be fitted with safety and control devices according to requirements of Part VIII "Instrumentation" of Rules for the Classification and Construction of Chemical Tankers.

2.4.10 Openings and pipelines of cargo tanks are to be fitted with closing devices capable to withstand cargo tank test pressure. Pipelines of cargo and gas exhaust system and inert gas system are to be located within cargo area and comply with requirements of Part VI "Systems and Piping" of Rules for the Classification and Construction of Chemical Tankers.

2.4.11 There is to be at least one tank for residual cargo and one settling tank onboard which are to comply with 9.3.2.26, ADN Regulations.

2.4.12 Cargo heating system is to comply with the requirements of Section 2, Part VI "Systems and Piping" of Rules for the Classification and Construction of Chemical Tankers.

2.5 REQUIREMENTS FOR TANKERS OF TYPE N

2.5.1 Tankers of type **N** are to comply with requirements of 2.4 as well as requirements of 13.4, Part III "Equipment, Arrangements and Outfit".

2.5.2 Some requirements of 2.4 may not be applied to open type **N** tankers or oil recovery ships and supply vessels if there is a special recommendation in 9.3.3, ADN Regulations.

2.6 REQUIREMENTS FOR SUPPLY OF SHIPS

2.6.1 In addition to the fire extinguishing appliances prescribed in Section 6, Part V "Fire Protection" each ship is to be equipped with at least two additional portable fire extinguishers having the same capacity. The fire extinguishing agent contained in these additional portable fire extinguishers is to be suitable and sufficient in quantity for fighting fires involving the dangerous goods carried.

2.6.2 Insofar as the provisions of Tables A or C, Chapter 3.2, ADN Regulations require, the following equipment is to be available on board:

.1 PP: for each member of the crew, a pair of protective goggles, a pair of protective gloves, a protective suit and a suitable pair of protective shoes (or protective boots, if necessary). On board tank ships, protective boots are required in all cases;

.2 EP: a suitable escape device for each person on board;

.3 EX: a flammable gas detector with the instructions for its use;

.4 TOX: a toximeter with the instructions for its use;

.5 A: a breathing apparatus ambient air-dependent.

2.6.3 Additional protective outfit and equipment specified by shipper in written instructions is to be submitted by the shipper and be kept onboard.

2.6.4 In case of pushers or moored groups it is enough that pushers or ships escorting moored groups are fitted with equipment listed in 2.4.2 if this equipment is listed in Tables A and C, Chapter 3.2, ADN Regulations.

2.7 REQUIREMENTS FOR SHIPS IN SERVICE

2.7.1 Ships in service are to comply with applicable requirements of ADN Regulations keeping due note of provisions of 1.6.7 "Transitional Provisions Concerning Vessels", Part 1, "General Provisions", ADN Regulations.

Российский морской регистр судоходства

Правила
классификации и постройки судов внутреннего плавания
(для Европейских внутренних водных путей)
2010 г.

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for the Classification and Construction of Inland Navigation Ships
(for European Inland Waterways)
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РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА

ГЛАВНОЕ УПРАВЛЕНИЕ

Санкт-Петербург

Циркулярное письмо

№ 002-4.1-458ц от 11. 02.2010

КАСАТЕЛЬНО: *Корректировки Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010 г.*	Ввод в действие	*15.02.2010*		
	Срок действия до	*31.12.2010*	Срок действия продлен до	
	Отменяет/изменяет/дополняет циркулярное письмо № - от			
ОБЪЕКТ НАБЛЮДЕНИЯ: *Классификационные освидетельствования*	Количество страниц	*2*		
Приложения: *Редакция п. 2.1.4 и п. 3.4.1, 1 стр.*				
Зам.генерального директора	подпись	*Баранов В.А.* (Ф.И.О.)		
Вносит изменения в *НД РС*	Название НД и № *НД 2-020101-059*			

В связи с необходимостью приведения Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010 г., в соответствие с конкретными главами Директивы 2006/87ЕС, в п.2.1.4 и в п. 3.4.1 части I,"Классификация" вносятся изменения (см. Приложение 1 к настоящему письму).

Необходимо выполнить следующее:

Ознакомить инспекторский состав, занятый в процессе освидетельствований судов в эксплуатации.

Исполнитель:	*Шебарский А.О.*	*002*	*312-92-53*
	Ф.И.О.	отд.	тел.

Приложение 1, к циркулярному письму № 002-4.1- 458ц от 11.02.2010

Правила классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010 г.

Часть I «Классификация. П. 2.1.4 изложить в следующей редакции:
«Класс судну присваивается или возобновляется Регистром на пятилетний период для пассажирских судов и на десятилетний период для других типов судов с условием проведения в течение указанных периодов промежуточных освидетельствований для подтверждения класса, объем и периодичность которых приведены в разд. 3.
В обоснованных случаях Регистр может присвоить или возобновить класс на меньший срок».

Начало п.3.4.1 изложить в следующей редакции:
«В обоснованных случаях по просьбе судовладельца Регистр может перенести срок очередного освидетельствования судна для возобновления класса на период не более 6 месяцев при условии предъявления судна к внеочередному освидетельствованию», и далее по тексту.

РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА
ГЛАВНОЕ УПРАВЛЕНИЕ
Санкт-Петербург

Циркулярное письмо

№ *010-2.ГрМ-460ц* **от** *12.02.2010 г.*

КАСАТЕЛЬНО: *Назначения надводного борта пассажирским судам внутреннего плавания в соответствии с положениями статьи 15.04 Директивы Европарламента 2006/87/ЕС (Article 15.04 of the Directive of the European Parliament and of the Council of 12 December 2006, 2006/87/EC)*	Ввод в действие	*с момента получения*		
	Срок действия до		Срок действия продлен до	
	Отменяет/изменяет/дополняет циркулярное письмо № ----- от			
ОБЪЕКТ НАБЛЮДЕНИЯ: *Постройка судов внутреннего плавания (для Европейских внутренних водных путей)*	Количество страниц	*1*		

Приложения: *нет*

Зам.генерального директора ______ (подпись) *Евенко В.И.* (Ф.И.О.)

Вносит изменения в	Название НД и №
Правила РС	*ПРАВИЛА КЛАССИФИКАЦИИ И ПОСТРОЙКИ СУДОВ ВНУТРЕННЕГО ПЛАВАНИЯ (для Европейских внутренних водных путей). № 2-020101-059*

В Часть IV "Остойчивость, деление на отсеки и надводный борт" вышеуказанных Правил вносятся следующие дополнения:

Глава 4.1 РАССТОЯНИЕ БЕЗОПАСНОСТИ дополняется пунктом 4.1.3:

4.1.3 Для пассажирских судов расстояние безопасности должно равняться, по меньшей мере, сумме следующих значений:

.1 измеренного по наружной обшивке дополнительного погружения борта при допустимом угле крена в соответствии 3.1.4, и

.2 остаточного расстояния безопасности в соответствии с 3.1.7.

Для судов, не имеющих палубы переборок, расстояние безопасности должно составлять не менее 500 мм.

Глава 4.3 МИНИМАЛЬНЫЙ НАДВОДНЫЙ БОРТ дополняется пунктами 4.3.2, 4.3.3 и 4.3.4:

4.3.2 Для пассажирских судов величина надводного борта должна равняться, по меньшей мере, сумме следующих значений:

.1 измеренного по наружной обшивке дополнительного погружения борта при угле крена в соответствии с 3.1.4, и

.2 остаточного надводного борта в соответствии с 3.1.7.

Однако надводный борт должен составлять не менее 300 мм.

4.3.3 Плоскость максимальной осадки для пассажирских судов должна определяться таким образом, чтобы соблюдались расстояние безопасности в соответствии с 4.1.3 и величина надводного борта в соответствии с 4.3.2, а также, выполнялись требования 2.7.1 и 3.1.

4.3.4 По соображениям безопасности Регистр может устанавливать большее расстояние безопасности или более высокую величину надводного борта.

Необходимо выполнить следующее:

Применять вышеуказанные требования при рассмотрении технической документации судов на соответствие Правилам классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), изд. 2010 г.

Исполнитель: *Анисимов Н.Б.* (Ф.И.О.) *010* (отд.) *(812) 312 85 72* (тел.)

РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА
ГЛАВНОЕ УПРАВЛЕНИЕ
Санкт-Петербург

Циркулярное письмо № 007-2.2-463ц от 11.03.2010

КАСАТЕЛЬНО: *Корректировка Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010г.*	Ввод в действие	*с момента получения письма*		
	Срок действия до		Срок действия продлен до	
	Отменяет/изменяет/дополняет циркулярное письмо № ____ от ____			
ОБЪЕКТ НАБЛЮДЕНИЯ: *Суда в постройке и в эксплуатации*	Количество страниц	*1 + 12*		
Приложения: *Текст изменений Правил на русском и английском языках - на 12 листах.*				
Зам.генерального директора	подпись	*В.И. Евенко* (Ф.И.О.)		
Вносит изменения в *Правила РС*	Название НД и № *Правила классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010г. (No 2-020101-059)*			

Настоящим циркулярным письмом в текст Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010г., вводятся изменения, учитывающие отдельные положения Директивы Европейского Парламента и Совета 2006/87/ЕС, ранее не учтенные в данных Правилах, а также Директивы 2008/126/ЕС и Директивы 2009/46/ЕС, исправляющих/дополняющих Директиву 2006/87/ЕС.

Текст изменений Правил прилагается.

Необходимо выполнить следующее:

С момента получения настоящего циркулярного письма прилагаемые изменения Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010г., следует учитывать в практической деятельности: при рассмотрении и одобрении технической документации на суда, при освидетельствованиях судов в постройке и в эксплуатации.

Исполнитель: *Пискорский В.Ф.* (Ф.И.О.) *007* (отд.) *(812) 312-24-28* (тел.)

Приложение к циркулярному письму
№ 007-2.2- 463ц от 11.03.2010

<u>Изменения и дополнения Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей) (2010г.) в соответствии с положениями Директивы Европейского Парламента и Совета 2006/87/ЕС, а также Директивы 2008/126/ЕС и Директивы 2009/46/ЕС, исправляющих/дополняющих Директиву 2006/87/ЕС</u>

Часть III. УСТРОЙСТВА, ОБОРУДОВАНИЕ И СНАБЖЕНИЕ

1.2 Определения и пояснения

1.2.5 Рулевое устройство и привод

1) Определение «Гидравлический привод с ручным управлением» заменяется следующим:

«Гидравлический привод с ручным управлением – гидравлическая передача, управляемая вручную».

2) Пояснения к определению «Источник энергии» в конце предложения дополняются словами «и рулевой машине».

3) Определение «Силовой агрегат рулевого привода» исключается.

4) Определение «Система управления рулевым приводом» заменяется следующим:

«Система управления рулевым приводом – механические и электрические компоненты, необходимые для работы механического рулевого привода».

5) Определения «Главный рулевой привод» и «Вспомогательный рулевой привод» исключаются.

6) Глава дополняется определением «Привод» в редакции:

«Привод – движущий механизм рулевой машины, расположенный между источником энергии и рулевой машиной».

2.1 Общие положения

2.1.1 В третьем абзаце вместо «+40^0 С» записывается «+50^0 С».

3.1 Общие положения

Глава дополняется пунктом **3.1.16** следующего содержания:

«**3.1.16** Носовая часть судна должна быть сконструирована таким образом, чтобы якоря ни полностью, ни частично не выступали за бортовую обшивку.»

2.9 Приводы рулевых машин

Пункты **2.9.8 - 2.9.10** заменяются текстом следующего содержания:

«**2.9.8** Если рулевое устройство оборудовано механическим приводом, то в случае повреждения или отказа в работе устройства управления рулевой машиной должна быть обеспечена возможность приведения в действие в течение 5 секунд вспомогательного независимого привода или включения ручного привода.

2.9.9 Если вспомогательный привод или ручной привод не приводятся в действие автоматически, должна быть предусмотрена возможность немедленного осуществления этого действия посредством одной простой и быстрой операции рулевого.

2.9.10 Независимо от положения пера руля, при автоматическом переключении на ручное управление не должно происходить самопроизвольного обратного вращения штурвала.»

3.2 Снабжение судов якорями, якорными цепями и тросами

3.2.1 Якоря пассажирских и грузовых самоходных судов.
Из названия исключается слово «самоходных».

3.2.1.1 Заменяется текстом следующего содержания:
«**3.2.1.1** Суда, предназначенные для перевозки грузов, за исключением судовых лихтеров длиной не более 40 м, должны быть оснащаться носовыми якорями, общая масса которых M_A, кг, должна рассчитываться по формуле:

$$M_A = kBT, \qquad (3.2.1.1\text{-}1)$$

где k – коэффициент, учитывающий взаимосвязь длины и ширины судна, а также его тип;

$$k = c\sqrt{(L/8B)} \qquad (3.2.1.1\text{-}2)$$

c – эмпирический коэффициент;
L – наибольшая длина судна, м;
B – наибольшая ширина судна, м;
T – максимально допустимая осадка, м.

Величина эмпирического коэффициента *c* определяется по табл. 3.2.1.1.

Таблица 3.2.1.1

Грузоподъемность судна, т	**Коэффициент *c***
до 400 включительно	45
от 400 до 650 включительно	55
от 650 до 1000 включительно	65
более 1000	70

При этом для лихтеров $k = c$

Для судов, дедвейт которых не превышает 400т и которые спроектированы и предназначены только для использования на определенных коротких маршрутах, по согласованию с Регистром массу носовых якорей допускается принять равной 2/3 требуемой массы M_A.
Пассажирские суда и суда, не предназначенные для перевозки, за исключением буксиров-толкачей, должны быть оборудованы носовыми якорями, общая масса которых в кг должна определяться согласно формулам (3.2.1.1-1), (3.2.1.1-2) и табл. 3.2.1.1, при этом вместо грузоподъемности необходимо применять водоизмещение судна в $м^3$.»

3.2.1.2 В первом абзаце слова «диаметральной плоскости» заменяются словами «средней части».
Второй абзац исключается.

3.2.1.3 Заменяется тестом следующего содержания:
«**3.2.1.3** Суда, предназначенные для толкания жесткосчаленных составов длиной не более 86м, должны быть оборудованы кормовыми якорями общей массой, равной 25% массы M_A, рассчитанной согласно 3.2.1.1 для формирований, рассматриваемых как навигационная единица.
Суда, предназначенные толкать вниз по течению жесткосчаленные составы длиной более 86 м, должны быть оборудованы кормовыми якорями общей массой, равной 50% массы M_A, рассчитанной согласно 3.2.1.1 для формирований, рассматриваемых как навигационная единица.»

3.2.1.4 Слова «пассажирские и самоходные грузовые» исключаются и пункт начинается со слова «Суда».
Второй абзац пункта заменяется текстом следующего содержания:

«Кормовые якоря не требуются:
- на судах, для которых вычисленная масса кормового якоря составляет менее 150 кг; для судов, дедвейт которых не превышает 400 т и которые спроектированы и предназначены только для использования на определенных коротких маршрутах, должна приниматься во внимание уменьшенная масса носовых якорей;
- на лихтерах.»

3.2.1.5 Начало первого абзаца заменяется следующим текстом:
«**3.2.1.5** Для судов, предназначенных для толкания, и судов максимальной длиной более 86 м» и далее по тексту.

Глава дополняется пунктом **3.2.1.6** следующего содержания:
«**3.2.1.6** При применении якорей повышенной держащей силы согласно 3.1.8 масса якорей, рассчитанных согласно 3.2.1.1 - 3.2.1.3 и 3.2.1.5, может быть уменьшена на 25%.»

3.2.2 Якоря других судов

3.2.2.1 Первый абзац заменяется текстом следующего содержания:
«Якорное снабжение толкачей и буксиров-толкачей, а также судовых лихтеров длиной 40 м и менее должно выбираться согласно табл. 3.2.2.1 в зависимости от характеристики снабжения N_A, м^2 , определяемой по формуле».

3.2.2.2 В начале первого абзаца слова «Для несамоходных судов» заменяются словами «Для судовых лихтеров».

3.2.2.2.1 и **3.2.2.2.2** Вместо слова «барж» записывается «судовых лихтеров».

3.2.2.3 Пункт исключается.

3.2.2.5.1 Слова «для самоходных и несамоходных судов» заменяются словами «для судовых лихтеров».

3.2.2.6 **«**40%» заменяется на «45%».

10.3 Выходы, проходы и трапы

10.3.7 Пункт дополняется текстом следующего содержания:
«Места прохода, предназначенные для использования лицами с ограниченной способностью для перемещения, должны иметь ширину в свету 1,3 м и не иметь дверных выступов и порогов высотой более 0,0025м. Выгородки в местах прохода, предназначенных для использования лицами с ограниченной способностью к передвижению, должны быть оборудованы поручнями, расположенными на высоте 0,9 м от палубы.»

10.4 Двери

10.4.2 Дополняется подпунктом **10.4.2.5** следующего содержания:
«.5 двери пассажирских помещений – наружу или раздвигаться».

Глава дополняется пунктом **10.4.6** следующего содержания:
«**10.4.6** Для дверей, предназначенных для использования лицами с ограниченной способностью к передвижению, в направлении открывания двери должно быть предусмотрено расстояние не менее 0,6 м между внутренней кромкой дверной коробки со стороны замка и прилегающей выгородкой, перпендикулярной ей.»

Часть VI. МЕХАНИЧЕСКИЕ УСТАНОВКИ

2.1.1 Заменяется следующим текстом:
«**2.1.1** Мощность главных механизмов должна обеспечивать скорость судна в грузу (или судна-толкача с груженым составом) не менее 13 км/ч с учетом требований Административной инструкции №1 Директивы 2008/126/ЕС, дополняющей Директиву 2006/87/ЕС.»

2.1.2 Первое предложение заменяется следующим текстом:

«**2.1.2** Механическая установка судна должна обеспечивать возможность работы на задний ход для необходимой маневренности судна (состава) при всех нормальных режимах эксплуатации, включая требования Административной инструкции №2 Директивы 2008/126/ЕС, дополняющей Директиву 2006/87/ЕС.»

Часть VII. СИСТЕМЫ И ТРУБОПРОВОДЫ

Дополняется пунктом 5.1.7 следующего содержания:

«**5.1.7** Если рабочая система трубопроводов не имеет открытого выхода в отсек, то в случае повреждения данного отсека трубопровод будет считаться неповрежденным, если он проложен в безопасной зоне на высоте не менее 0,50 м от днища судна.»

Дополняется пунктами 11.1.9 и 11.1.10 следующего содержания:

«**11.1.9** Вентиляционные каналы должны быть оснащены закрывающимися отверстиями для осмотра и очистки. Эти отверстия должны быть расположены поблизости от противопожарных заслонок.

11.1.10 Посты управления, лестничные шахты и внутренние пути эвакуации должны быть оборудованы системами естественной или принудительной вытяжки дыма. Системы вытяжки дыма должны отвечать следующим требованиям:
.1 они должны обладать достаточной пропускной способностью и надежностью;
.2 они должны соответствовать рабочим условиям для пассажирских судов;
.3 если системы вытяжки дыма используются также в качестве вентиляторов общего назначения для помещений, это не должно препятствовать выполнению ими функции систем вытяжки дыма в случае пожара;
.4 системы вытяжки дыма должны быть снабжены пусковым устройством, управляемым вручную;
.5 для принудительных систем вытяжки дыма должна быть дополнительно предусмотрена возможность управления ими с поста, где постоянно находится персонал судна или члены экипажа;
.6 системы естественной вытяжки дыма должны быть оборудованы механизмом открытия, управляемым вручную или от источника энергии, являющегося элементом этой системы;

.7 к пусковым устройствам и механизмам открытия с ручным приводом должен быть обеспечен доступ изнутри или извне защищаемого помещения.»

Часть IX. ЭЛЕКТРИЧЕСКОЕ ОБОРУДОВАНИЕ

19.1.3.1.1 Текст «проходов, трапов жилых и служебных помещений и выходов на открытую палубу, а также кабин пассажирских лифтов;» заменяется следующим текстом:
«проходов, трапов жилых и служебных помещений и выходов на открытую палубу, других помещений, предназначенных для лиц с ограниченной способностью к передвижению, а также кабин пассажирских лифтов;»

Часть XI. РАДИООБОРУДОВАНИЕ

3.4.6 Пункт в конце после слов «якорно-швартовными устройствами» дополняется следующим текстом:
«, а также на пассажирских судах в местах сбора и эвакуации пассажиров, соответствующих требованиям раздела 8 части III «Устройство, оборудование и снабжение», при условии, что в этих местах отсутствует альтернативная прямая переговорная связь с помещением ходового мостика.»

Часть XIII. СРЕДСТВА ПО ПРЕДОТВРАЩЕНИЮ ЗАГРЯЗНЕНИЯ С СУДОВ

2.7.2.1. В первом предложении, словосочетание «… фланцы со стандартными размерами в соответствии с рис. 2.7.2.1, либо …» исключается.
Второе и третье предложения заменяются следующим текстом:
«В обоснованных случаях, по согласованию с Регистром, трубопровод может быть выведен в одном удобном для присоединения шланга месте, обеспечивающем выдачу на оба борта».

Рис. 2.7.2.1 с текстом удаляется.

3.4.1. В первом предложении название указанного стандарта «EN 1305:1996» заменяется на «EN 1306:1996». После первого предложения вводится текст:
«Сливные соединения пассажирских судов должны быть оборудованы такими быстроразъемными соединениями.»

Существующие второе и третье предложения заменяются следующим текстом:
«В обоснованных случаях, по согласованию с Регистром, трубопровод может быть выведен в одном удобном для присоединения шланга месте, обеспечивающем выдачу на оба борта. Должна быть обеспечена возможность беспрепятственного прохода через судно выдаваемых сточных и хозяйственно-бытовых вод с других судов.»

6.2.1. Вводятся определения:
«Семейство двигателей – означает совокупность двигателей, определенных изготовителем и утвержденных компетентным органом, которые по своей конструкции должны иметь аналогичные характеристики, касающиеся уровня выбросов выхлопных газов и загрязняющих воздух частиц, и удовлетворять требованиям настоящей части.»

«Типовое одобрение - означает процедуру, как определено в статье 2 Директивы 97/68/ЕС с изменениями, посредством которой Администрацией удостоверяется, что тип двигателя или семейство двигателей удовлетворяет применимым техническим требованиям к уровню выбросов из двигателей.»

«Заменяющий двигатель - находившийся в эксплуатации и прошедший капитальный ремонт двигатель, предназначенный для замены существующего двигателя, принадлежащий к тому же типу (однорядный, V-образный двигатель), имеющий то же количество цилиндров, что и подлежащий замене двигатель, номинальная мощность и число оборотов которого не отличаются более чем на 10% от номинальной мощности и числа оборотов двигателя, подлежащего замене.»

«Вспомогательный двигатель – дизельный двигатель, применяемый для целей иных, чем двигатель в составе пропульсивной установки судна.»

6.2.1. Название и определение «Журнал регистрации параметров двигателя» заменяется следующим текстом:

«Протокол параметров двигателя – документ, форма которого приведена в Приложении V к Директиве 2009/46/ЕС, для записи всех конструктивных изменений, параметров, регулировок и компонентов, влияющих на уровень выбросов из двигателя.»

Вводится пункт **6.3.5** следующего содержания:

«**6.3.5** Двигатели, указанные в 6.3.1, должны иметь Свидетельства о типовом одобрении, выданные по результатам первичного освидетельствования в соответствии с Директивой 97/68/ЕС, или Свидетельства, признанные эквивалентными, выданные в соответствии с параграфом 2 Приложения XII к указанной Директиве. Копии Свидетельств должны храниться постоянно на борту судна.»

Вводится пункт **6.3.6** следующего содержания:

«**6.3.6** Применение двигателей, имеющих типовое одобрение, на судне должно производиться в соответствии с Административной инструкцией №23, приведенной в Приложении II к Директиве 2009/46/ЕС.»

Существующему пункту **6.3.5** присваивается номер **6.3.7**.

Вводится пункт **6.3.8** следующего содержания:

«**6.3.8** В случае двигателей с системами очистки выхлопных газов, эти системы должны быть проверены согласно инструкций в Техническом файле выбросов двигателя, что подтверждается при освидетельствованиях в 6.3.7.»

Существующему пункту **6.3.6** присваивается номер **6.3.9**.

Существующему пункту **6.3.7** присваивается номер **6.3.10**. Текст заменяется следующим: «**6.3.10** После каждого изменения в двигателе, если такие изменения могут повлиять на выбросы, за исключением допускаемых регулировок и замены компонентов, указанных изготовителем в одобренном Техническом файле выбросов двигателя, должны быть проведены специальные испытания, подтверждающие, что, несмотря на изменения, уровень выбросов удовлетворяет требованиям настоящей главы.»

Amendments and additions to Rules for the Classification and Construction of Inland Navigation Ships (for European Inland Waterways) (2010)
In compliance with Directive of the European Parliament and of the Council 2006/87/EC, as well as Directive 2008/126/EC and Directive 2009/46/EC amending/supplementing Directive 2006/87/EC

Part III. EQUIPMENT, ARRANGEMENTS AND OUTFIT

1.2 Definitions and explanations

1.2.5 Rudder and steering gear

1) Definition 'Hand-operated hydraulic steering gear' has been replaced by:

'Manually-operated hydraulic drive: a manual control actuating a hydraulic transmission'.

2) Explanation to definition 'Power source' in the end of the sentence has been supplemented by the words 'and the steering gear'.

3) Definition 'Steering gear power unit' has been deleted.

4) Definition 'Steering gear control system' has been replaced by:

'Steering control': the component parts of and circuitry for the operation of a power-driven steering control'.

5) Definitions 'Main steering gear' and 'Auxiliary steering gear' have been deleted.

6) The Chapter has been supplemented by definition 'Drive unit' reading as follows:

'Drive unit': the steering gear drive, between the power source and the steering gear'. **2.1 General**

2.1.1 In the third paragraph '+40^0 C' has been replaced by '+50^0 C'.

3.1 General

The Chapter has been supplemented by **3.1.16** reading as follows:
'**3.1.16** The foresections of ships shall be built in such a way that the anchors neither wholly nor partly protrude beyond the side plating.'

2.9 Steering gear

The text of **2.9.8** to **2.9.10** has been amended to read:
'**2.9.8** If the steering gear has a powered drive unit, it shall be possible to bring a second independent drive unit, or manual drive, into use within five seconds if the steering gear drive unit fails or malfunctions.

2.9.9 If the second drive unit or manual drive is not placed in service automatically, it shall be possible to do so immediately by means of a single operation by helmsman that is both simple and quick.

2.9.10 Regardless of rudder position, a kick-back of the wheel shall be prevented when the manual drive is engaged automatically.'

3.2 Supply of ships with anchors, anchor chains and cables

3.2.1 Anchors of passenger and self-propelled cargo ships.
The word 'self-propelled' has been deleted from the title.

3.2.1.1 has been amended to read:
'**3.2.1.1** Ships intended for the carriage of goods, apart from ship-borne lighters whose length L does not exceed 40m, shall be equipped with bow anchors whose total mass M_A in kg, is obtained using the following formula

$$M_A = k BT \text{ (kg)} \qquad (3.2.1.1\text{-}1)$$

where
k is a coefficient that takes account of the relationship between length L and beam B, and of the type of ship;

$$k = c \sqrt{(L/8B)} \qquad (3.2.1.1\text{-}2)$$

c is an empirical coefficient;
L is a maximum length of the ship, in m;
B is a maximum beam of the ship, in m;
T is a maximum allowable draught, in m.

The value of empirical coefficient *c* is determined according to Table 3.2.1.1.

Table 3.2.1.1

Dead-weight tonnage in t	**Coefficient *c***
up to 400 inclusive	45
from 400 to 650 inclusive	55
from 650 to 1000 inclusive	65
more than 1000	70

For lighters, however, $k = c$ will be taken

On ships whose dead-weight tonnage is not greater than 400 t and which, owing to their design and intended purpose, are used only on predetermined short-haul sections, the Register may accept that only two-thirds of total mass M_A is required for the bow anchors.

Passenger ships and ships not intended for the carriage of goods, apart from pushers, shall be fitted with bow anchors whose total mass M_A, in kg, is obtained using the formulas (3.2.1.1-1), (3.2.1.1-2) and Table 3.2.1.1, using the displacement, in m^3, instead of the deadweight tonnage'

3.2.1.2 In the first paragraph the words 'in the centerline of the ship' have been replaced by the word 'amidships'.
The second paragraph has been deleted.

3.2.1.3 has been amended to read:
'**3.2.1.3** Ships intended to propel rigid convoys which do not exceed 86 m in length shall be equipped with stern anchors whose total mass is equal to 25 per cent of maximum mass M_A calculated in accordance with paragraph 3.2.1.1 for the formations considered to be a nautical unit.

Ships intended to propel rigid convoys which exceed 86 m in length downstream shall be equipped with stern anchors whose total mass is equal to 50 per cent of the maximum mass M_A calculated in accordance with paragraph 3.2.1.1 for the formations considered to be a nautical unit.'

3.2.1.4 The words 'passenger and self-propelled cargo' have been deleted and the paragraph begins with the word 'Ships'.

The second paragraph has been amended to read:
'Stern anchors are not required for:
- ships for which the stern anchor mass will be less than 150 kg; in the case of ships whose dead-weight tonnage is not greater than 400 t and which, owing to their design and intended purpose, are used only on predetermined short-haul sections, the reduced mass of the bow anchors shall be taken into account;
- lighters.'

3.2.1.5 The beginning of the second paragraph has been amended to read:
'**3.2.1.5** For pushers and ships whose maximum length exceeds 86m', the rest remaining as it stands.

The Chapter has been supplemented by **3.2.1.6** reading as follows:
'3.2.1.6 Where high holding power anchors referred to in 3.1.8 are applied, the anchor masses established in accordance with 3.2.1.1 to 3.2.1.3 and 3.2.1.5 may be reduced by 25 per cent.'

3.2.2 Anchors of other ships

3.2.2.1 The first paragraph has been amended to read:
'Anchor equipment of pushers and tugs as well as of ship-borne lighters whose length does not exceed 40m, shall be chosen in accordance with Table 3.2.2.1 based on the Equipment Number N_A, m^2, determined by the formula.'

3.2.2.2 In the beginning of the first paragraph the words 'For non-self-propelled ships' have been replaced by the words 'For ship-borne lighters'.

3.2.2.2.1 and **3.2.2.2.2** The word 'barges' has been replaced by the words 'ship-borne lighters'.

3.2.2.3 has been deleted.

3.2.2.5.1 The words 'for self-propelled and non-self-propelled ships' have been replaced by the words 'for ship-borne lighters'.

3.2.2.6 '40 per cent' has been replaced by '45per cent'.

10.3 Exits, passageways and stairways

10.3.7 has been supplemented by the text reading as follows:
'Passageways intended for use by persons with reduced mobility shall have a clear width of 1,30 m and be free of doorsteps and sills more than 0,025 m high. Walls in passageways intended for use by persons with reduced mobility shall be equipped with handrails at a height of 0,90 m above the floor.'

10.4 Doors

10.4.2 has been supplemented by sub-paragraph **10.4.2.5** reading as follows:
'**.5** doors of passenger rooms shall be capable of opening outwards or be constructed as sliding doors'.

The Chapter has been supplemented by **10.4.6** reading as follows:
'10.4.6 For doors intended for use by persons with reduced mobility, there shall be from the direction from which the door opens, a minimum clearance of 0,60 m between the inner edge of the doorframe on the lock side and an adjacent perpendicular wall.'

Part VI. MACHINERY INSTALLATIONS

2.1.1 has been replaced by the following text:
«**2.1.1** Power of the main machinery is to provide the speed of the ship under loaded condition (or of a pusher tug with towing train) of at least 13 km per hour considering the requirements of Administrative instruction №1 Directive 2008/126/EC amending Directive 2006/87/EC »

2.1.2 The first sentence has been replaced by the following text:
«**2.1.2** The machinery installation is to provide sufficient astern manoeuvring of the ship (towing train) under all normal service conditions including requirements Administrative instruction №2 Directive 2008/126/EC amending Directive 2006/87/EC.»

Part VII. SYSTEMS AND PIPING

Has been added with paragraph 5.1.7 reading as follows:

«**5.1.7** Where a system has no open outlet in a compartment, the pipeline shall be regarded as intact in the event of this compartment being damaged, if it runs within the safe area and is more than 0,50 m from the bottom of the ship.»

Has been added with paragraphs 11.1.9 and 11.1.10 reading as follows:

«**11.1.9** Air extraction ducts shall be provided with lockable openings for inspection and cleaning. These openings shall be located close to the fire dampers.

11.1.10 Control centres, stairwells and internal evacuation areas shall be fitted with natural or mechanical smoke extraction systems. Smoke extraction systems shall satisfy the following requirements:
.1 they shall offer sufficient capacity and reliability;
.2 they shall comply with the operating conditions for passenger ships;
.3 if smoke extraction systems also serve as general ventilators for the rooms, this shall not hinder their function as smoke extraction systems in the event of a fire;
.4 smoke extraction systems shall have a manually operated triggering device;
.5 mechanical smoke extraction systems shall additionally be such that they can be operated from a location permanently manned by shipboard personnel or crew members;
.6 natural smoke extraction systems shall be fitted with an opening mechanism, operated either manually or by a power source inside the extraction system;
.7 manually operated triggering devices and opening mechanisms shall be accessible from inside or outside the room being protected.»

Part IX. ELECTRICAL EQUIPMENT

19.1.3.1.1 «passageways, stairways of accommodation and service spaces, and exits to the open deck, as well as of passenger lift cars;» has been replaced by the following text:
« passageways, stairways of accommodation and service spaces, and exits to the open deck, other areas intended for use by persons with reduced mobility as well as of passenger lift cars;»

PART XI. RADIOEQUIPMENT

3.4.6 The following text is added after the words «anchor and mooring arrangements»:
« as well as on all passenger ships in the access and evacuation areas for passengers corresponding with the requirements of section 8, Part III "Equipment , Arrangements and Outfit" where there is no alternative direct communication from the wheelhouse.»

Part XIII. MEANS FOR THE PREVENTION OF POLLUTION FROM SHIPS

2.7.2.1. In the first sentence the following phrase is deleted «… flanges of standard dimensions in accordance with Fig. 2.7.2.1 or …».
The second and third sentence have been replaced by the following text:
«Upon the Register approval in justified cases the pipeline may have an outlet in one place convenient for connection enabling discharge to both sides ».
Fig. 2.7.2.1 with text is deleted.

3.4.1. Name of standard «EN 1305:1996» is replaced by «EN 1306:1996» in the first sentence. The following text is introduced after the first sentence:
« Discharge manifolds are to be fitted with such quick-release type connections ».

Existing second and third sentence have been replaced by the following text:
«Upon the Register approval in justified cases the pipeline may have an outlet in one place convenient for connection enabling discharge to both sides. It shall be possible to pass sewage and domestic waste water from other ships through».

6.2.1. The following definitions are introduced:
« Engine family" means a manufacturer's grouping of engines which through their design, are expected to have similar exhaust emission characteristics of gaseous and particulate pollutants as required in the present part ».

« "Type-approval" means the procedure as defined in Article 2, second indent of Directive 97/68/EC, as amended, whereby an Administration certifies that an engine type or an engine family with regard to the level of emission of gaseous and particulate pollutants by the engine(s) satisfies the relevant technical requirements».

« “Exchange engine” means a used, overhauled engine which is intended to replace a currently operational engine and which is of the same design (in-line engine, V-engine) as the engine to be replaced, which has the same number of cylinders and whose power output and speed do not differ by more than 10 % from the power output and speed of the engine to be replaced».

«“Auxiliary engine” means a diesel engine for use in applications other than the propulsion of a craft».

6.2.1. The name and definition « Engine parameter protocol » has been replaced by the following text:

«“Engine parameter protocol” means the document pursuant to Appendix V, Directive 2009/46/EC in which all the parameters, together with changes, and including components and engine settings which affect the level of emission of gaseous and particulate pollutants from the engine are duly recorded»

A new paragraph **6.3.5** reading as follows is introduced:

«**6.3.5** Engines listed in 6.3.1 are to hold Type approval certificates issued upon results of the initial survey pursuant to Directive 97/68/EC or type approval certificates which, pursuant to paragraph 2, Appendix XII Directive 97/68/EC are recognised as equivalent. Copies of Certificates shall be kept available on board.»

A new paragraph **6.3.6** reading as follows is introduced:

«**6.3.6** Engines holding type approval are to be used onboard pursuant to Administrative instruction No 23, Appendix II Directive 97/68/EC ».

Paragraph **6.3.5** is renumbered to **6.3.7**.

A new paragraph **6.3.8** reading as follows is introduced:

«**6.3.8** If engines are fitted with the exhaust gas cleaning system, these systems are to be checked pursuant to the instruction in the Technical File of Marine Diesel Engine which is confirmed during surveys in 6.3.7».

Paragraph **6.3.6** is renumbered to **6.3.9**.

Paragraph **6.3.7** is renumbered to **6.3.10**. A new text is introduced: «**6.3.10** If any modifications are made in the engine that may affect emissions except permissible tuning and change of components specified by the manufacturer in the approved Technical File of Marine Diesel Engine , then special tests are to be performed to confirm that the level of emission still complies with the requirements of the present chapter despite such modifications ».

РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА
ГЛАВНОЕ УПРАВЛЕНИЕ
Санкт-Петербург

Циркулярное письмо № 007-2.2-507ц от 29.12.2010

КАСАТЕЛЬНО: *Корректировка Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010 г.*	Ввод в действие	*с момента получения письма*		
	Срок действия до		Срок действия продлен до	
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Приложения: *Текст изменений Правил - на 27 листах.*

Зам.генерального директора		*В.И. Евенко*
	подпись	Ф.И.О.

Вносит изменения в *Правила РС*	Название НД и № *Правила классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010г. (No 2-020101-059)*

Настоящим циркулярным письмом в текст Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010 г., вводятся изменения, учитывающие некоторые положения Директивы Европейского Парламента и Совета 2006/87/ЕС и Правил ВОПОГ-2009, которые не были учтены в данных Правилах, а также требования некоторых административных инструкций (Nos. 1, 2, 3, 5, 8, 9, 12, 17, 18, 20, 21, 22, 24) Директивы 2008/126/ЕС, дополняющей Директиву 2006/87/ЕС.

Текст изменений Правил прилагается.

Необходимо выполнить следующее:

С момента получения настоящего циркулярного письма прилагаемые изменения Правил классификации и постройки судов внутреннего плавания (для Европейских внутренних водных путей), 2010 г., следует учитывать в практической деятельности: при рассмотрении и одобрении технической документации на суда, при освидетельствованиях судов в постройке и в эксплуатации.

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Приложение к циркулярному письму
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Изменения и дополнения
Правил классификации и постройки судов внутреннего плавания
(для Европейских внутренних водных путей) (2010 г.)

ЧАСТЬ I. КЛАССИФИКАЦИЯ

1.1 ОПРЕДЕЛЕНИЯ

1.1.2 Типы судов.

В определении «Плавучая установка» слово «док» заменяется словами «плавучий док», а слова «дебаркадер или лодочная станция» заменяются словами «дебаркадер, лодочная станция, плавучая мастерская, плавучая гостиница или общежитие, плавучее судно-склад и т. д.».

Определение «Судно-площадка» заменяется следующим текстом:

«Судно-площадка – сухогрузное судно, перевозящее груз на палубе и не имеющее надстроек на палубе надводного борта.».

1.2 ПОЯСНЕНИЯ

1.2.3.4 заменяется следующим текстом:

«**.4** на высокоскоростные суда внутреннего плавания распространяются применимые требования Правил классификации и постройки высокоскоростных судов с учетом положений главы 22b Директивы 2006/87/ЕС;».

Вводится новый пункт **1.2.3.5** следующего содержания:

«**.5** на прогулочные суда внутреннего плавания распространяются применимые требования Правил классификации и постройки малых прогулочных судов с учетом положений главы 21 Директивы 2006/87/ЕС.».

2.2 СИМВОЛ КЛАССА СУДНА

2.2.8 Словесная характеристика в символе класса.

Перечисление словесных характеристик (до слов «и так далее») дополняется следующими словесными характеристиками:

Day-trip passenger ship – пассажирское судно для однодневных экскурсий

Floating establishment – плавучая установка

Flush-deck ship – судно-площадка

Lighter – лихтер

Oil recovery ship – нефтесборное судно

Passenger sailing ship – пассажирское парусное судно

Pushed barge – толкаемая баржа

Shipborne barge – судовая баржа

Towed barge – буксируемая баржа

После слов «и так далее» дополняется следующим текстом:

«Словесные характеристики высокоскоростных судов – в соответствии с Правилами классификации и постройки высокоскоростных судов.

Словесные характеристики прогулочных судов – в соответствии с Правилами классификации и постройки малых прогулочных судов.

Со словесной характеристикой **Floating establishment** в скобках указывается конкретное назначение судна из перечисленного в определении «Плавучая установка» (см. 1.1). Например: **Floating establishment (floating dock**, или **swimming bath**, или **floating workshop**, или **jetty**, или **floating warehouse**, и т. д.).», и далее по тексту.

2.5 СУДОВЫЕ ДОКУМЕНТЫ РЕГИСТРА

2.5.2 дополняется следующим текстом:
«с учетом Административной инструкции № 11 Директивы 2008/126/EC, дополняющей Директиву 2006/87/EC.».

ЧАСТЬ II. КОРПУС

3.1 НАЛИВНЫЕ СУДА

3.1.1.1 заменяется следующим текстом:

«**3.1.1.1** Требования настоящей главы распространяются на наливные суда, предназначенные для перевозки сырой нефти и нефтепродуктов, а также иных опасных грузов, допущенных для перевозки на наливных судах типа **G**, типа **C** и типа **N**.

Конструкция корпуса наливных судов, предназначенных для перевозки иных жидкостей, а также конструкция корпуса наливных судов типа **G**, не оговоренная в настоящей главе, является предметом специального рассмотрения Регистром.

Требования к конструкции грузовых танков высокого давления являются предметом специального рассмотрения Регистром. Прочность конструкций грузовых танков высокого давления должна быть проверена на рабочее давление 400 кПа и на температуру груза + 40 ^{o}C по одобренной Регистром методике.».

3.1.2.1.2 Четвертый абзац после слов «между поперечными переборками» заменяется следующим текстом:

«, а также длина грузовых танков наливных судов типа **C** и типа **N** (за исключением вкладных танков цилиндрической формы) должны быть не более 0,2L, или 10 м, в зависимости от того, что больше.».

Последний абзац заменяется следующим текстом:

«Для вкладных грузовых танков цилиндрической формы, а также грузовых танков высокого давления наливных судов типа **G**, отношение длины танка к диаметру танка не должно превышать 7.».

3.1.2.2.1 Текст второго абзаца исключается.

Вводится новый пункт **3.1.2.2.7** следующего содержания:

«3.1.2.2.7 Переборки, ограничивающие грузовые танки, коффердамы и трюмные помещения судов типа **G**, типа **C** и типа **N**, должны быть водонепроницаемыми. В грузовых танках и в переборках, ограничивающих грузовое пространство, не должно быть отверстий или проходов, расположенных под палубой.».

Номер существующего пункта **3.1.2.2.7** заменяется номером **3.1.2.2.8**. После слов «не менее 600 мм» текст пункта дополняется следующим текстом:

«и расположение и оборудование цистерн соответствуют требованиям 9.1.7 и 12.7.8 части VII «Системы и трубопроводы».».

3.1.2.2.9 исключается.

3.1.2.2.10 исключается.

3.1.2.2.11 исключается.

Вводится новый пункт **3.1.2.3** следующего содержания:

«**3.1.2.3** Требования к конструкции корпуса наливного судна типа **G**.

3.1.2.3.1 В пределах грузового пространства:

.1 для судна, оборудованного двойным дном и двойными бортами, ширина междубортового пространства должна быть не менее 800 мм, высота междудонного пространства должна быть не менее 600 мм. Грузовые танки должны поддерживаться при помощи опор, проходящих между танками ниже их горизонтальной диаметральной линии под углом не менее 20 °;

.2 на судне с одинарными бортами между площадкой сходного трапа и верхом флора должны быть установлены бортовые стрингеры с расстоянием между ними не более 600 мм, которые должны поддерживаться рамными шпангоутами, отстоящими друг от друга не более чем на 2 м. Высота бортовых стрингеров и рамных шпангоутов должна составлять не менее 10 % высоты борта, но не менее 300 мм. Бортовые стрингеры и рамные шпангоуты должны быть снабжены свободным пояском, изготовленным из полосовой стали и имеющим площадь поперечного сечения не менее 7,5 см^2 и 15 см^2, соответственно.

Расстояние между бортовой обшивкой судна и грузовыми танками должно составлять не менее 800 мм, а между днищевой обшивкой и грузовыми танками - не менее 600 м. Под приемными колодцами расстояние до днищевой обшивки может быть уменьшено до 500 мм.

Расстояние по горизонтали между приемными колодцами грузовых танков и элементами конструкции днища должно составлять не менее 100 мм.

Опорные устройства и крепежные приспособления грузовых танков должны проходить ниже горизонтальной диаметральной линии грузовых танков под углом не менее 10 °.

3.1.2.3.2 Грузовые танки должны быть закреплены так, чтобы исключалась возможность люфта.

3.1.2.3.3 Запрещается установка стоек, соединяющих или поддерживающих несущие конструкции борта судна с несущими конструкциями продольной стенки грузового танка, а также стоек, соединяющих несущие конструкции днища судна с днищем грузового танка.

3.1.2.3.4 Вместимость приемного колодца должна составлять не более 0,10 м^3. В случае грузовых танков высокого давления вместимость приемного колодца может быть увеличена до 0,20 м^3.

3.1.2.3.5 Трюмные помещения должны быть отделены от жилых и служебных помещений, расположенных за пределами подпалубного грузового пространства, при помощи переборок типа «А-60». Расстояние между грузовыми танками и концевыми переборками трюмных помещений должно быть не менее 200 мм. Если грузовые танки имеют плоские концевые переборки, это расстояние должно быть не менее 500 мм.

3.1.2.3.6 В пределах подпалубного грузового пространства может быть оборудовано служебное помещение при условии, что переборка, ограничивающая это служебное помещение, доходит в вертикальной плоскости до дна, а переборка, не обращенная в сторону грузового пространства, тянется от борта до борта в плоскости одной шпангоутной рамы. Вход в это служебное помещение должен быть предусмотрен только с палубы.».

Вводится новый пункт **3.1.2.4** следующего содержания:

«**3.1.2.4** Требования к конструкции корпуса наливного судна типа **C**.

3.1.2.4.1 В пределах грузового пространства, за исключением коффердамов, судно должно быть сконструировано как гладкопалубное судно с междудонными пространствами и междубортовыми пространствами.

3.1.2.4.2 Грузовые танки, не являющиеся частью корпуса, должны быть закреплены так, чтобы исключалась возможность люфта.

3.1.2.4.3 Вместимость приемного колодца должна составлять не более 0,10 м^3.

3.1.2.4.4 Запрещается установка стоек, соединяющих или поддерживающих несущие конструкции борта судна с несущими конструкциями продольной стенки грузового танка, а также стоек, соединяющих несущие конструкции днища судна с днищем грузового танка.

3.1.2.4.5 В палубе грузовых танков допускается оборудование отдельных колодцев глубиной более 0,1 м при условии:

.1 глубина колодца не более 1 м;

.2 колодец удален от входов и отверстий жилых и служебных помещений, расположенных за пределами грузового пространства, по меньшей мере, на 6 м, и от бортов судна – на расстоянии равном ¼ ширины судна *B*.

3.1.2.4.6 Грузовые танки должны быть отделены от жилых помещений, машинного отделения и служебных помещений, расположенных за пределами подпалубного грузового пространства, или, при отсутствии таких помещений, от оконечностей судна коффердамами шириной не менее 600 мм.

3.1.2.4.7 Вкладные грузовые танки должны отстоять от концевых переборок трюмного помещения на расстояние не менее 500 мм. Концевая переборка типа «А-60» может считаться эквивалентной коффердаму. Для грузовых танков высокого давления указанное расстояние должно быть не менее 200 мм.

3.1.2.4.8 Коффердам, центральная часть коффердама или иное пространство, расположенное под палубой в пределах грузового пространства, могут быть оборудованы как служебное помещение, если оно ограничено со всех сторон водонепроницаемыми переборками, доходящими до днищевой обшивки. Вход в него должен быть предусмотрен только с палубы.

3.1.2.4.9 Для судна со встроенными грузовыми танками ширина междубортового пространства должна быть не менее 1000 мм. Допускается уменьшение этого расстояния до 800 мм при условии, что будут выполнены следующие усиления корпуса (по отношению к указанным в соответствующих разделах):

.1 толщина палубного стрингера должна быть увеличена на 25 %;

.2 толщина наружной обшивки борта должна быть увеличена на 15 %;

.3 при продольной системе набора борта должны быть установлены продольные бортовые балки со шпацией не более 500 мм с высотой не менее 150 мм и площадью поперечного сечения свободного пояска не менее 7 см^2;

.4 при поперечной системе набора борта должны быть установлены бортовые стрингеры с расстояниями между ними не более 800 мм с высотой, превышающей высоту шпангоутов на величину не менее 150 мм и площадью поперечного сечения свободного пояска не менее 7 см^2. Бортовые стрингеры должны быть приварены к шпангоутам. При наличии вырезов в стрингерах в местах их соединения со шпангоутами высота стенки стрингера должна быть увеличена на величину ширины выреза;

.5 бортовые стрингеры и бортовые продольные балки должны поддерживаться диафрагмами, отстоящими друг от друга не более чем на 1,8 м.

Средняя высота междудонного пространства должна составлять 700 м, но не менее 600 мм. Высота междудонного пространства в районе приемных колодцев грузовых насосов может быть уменьшена до 500 мм.

3.1.2.4.10 Для судна с вкладными грузовыми танками ширина междубортового пространства должна быть не менее 800 мм, высота междудонного пространства должна быть не менее 600 мм.».

Вводится новый пункт **3.1.2.5** следующего содержания:

«**3.1.2.5** Требования к конструкции корпуса наливного судна типа **N**.

3.1.2.5.1 Конструкция корпуса наливного судна типа **N** должна отвечать требованиям 3.1.2.4.2, 3.1.2.4.3 и 3.1.2.4.6 – 3.1.2.4.8.

3.1.2.5.2 Для судов:

оборудованных двойным дном и двойными бортами и судовыми цистернами, являющимися частью конструкции корпуса судна;

оборудованных двойным дном и двойными бортами и грузовыми танками, являющимися частью конструкции корпуса судна;

с трюмными помещениями и грузовыми танками, не являющимися частью конструкции корпуса судна;

с вкладными грузовыми танками,

расстояние между бортовой обшивкой и обшивкой грузовых танков должно быть не менее 600 мм.

3.1.2.5.3 Расстояние между днищевой обшивкой и днищем грузовых танков должно быть не менее 500 мм. Указанное расстояние в районе приемных колодцев насосов может быть уменьшено до 400 мм.

3.1.2.5.4 Расстояние по вертикали между приемным колодцем грузового танка и днищевым набором корпуса судна должно быть не менее 100 мм.

3.1.2.5.5 Требования 3.1.2.5.2 – 3.1.2.5.4 распространяются на двойные борта и двойное дно судов, оборудованных двойным дном и двойными бортами в пределах грузовой зоны, и судов с вкладными грузовыми танками в трюмных помещениях. В случае если указанные требования не могут быть выполнены в связи с необходимостью выполнения требования 13.2.8 части III «Устройство, оборудование и снабжение», должна быть предусмотрена возможность беспрепятственного извлечения грузовых танков из корпуса судна для проведения необходимых мероприятий.».

Номера существующих пунктов **3.1.2.3** и **3.1.2.4** заменяются номерами 3.1.2.6 и 3.1.2.7 соответственно.

3.7 СУДА СУХОГРУЗНЫЕ ДЛЯ ПЕРЕВОЗКИ ОПАСНЫХ ГРУЗОВ

3.7.2 Слова «в районе грузовых трюмов» заменяются словами «в пределах защищенной зоны».

3.7.5 дополняется следующим текстом:

«Вместимость приемных колодцев не должна превышать 0,120 м^3.».

ПРИЛОЖЕНИЕ. КОНТРОЛЬ НЕПРОНИЦАЕМОСТИ КОРПУСА

Таблица

Текст первого столбца пункта 7.1 заменяется следующим текстом:
«Грузовые отсеки наливного судна типа N[3, 4]».

Текст первого столбца пункта 7.2 заменяется следующим текстом:
«Грузовые отсеки наливного судна типа C[3, 4]».

Текст первого столбца пункта 8 заменяется следующим текстом:
«Коффердамы[3]».

Таблица дополняется следующими примечаниями:
«[3] Периодичность испытаний в эксплуатации не реже чем 1 раз в 11 лет.

[4] При испытаниях грузовых танков и цистерн для остатков груза испытательное давление должно быть не менее 1,3 расчетного давления. Испытательное давление при испытаниях открытых грузовых танков должно быть не менее 10 кПа (0,10 бар).».

ЧАСТЬ III. УСТРОЙСТВА, ОБОРУДОВАНИЕ И СНАБЖЕНИЕ

2.1 ОБЩИЕ ПОЛОЖЕНИЯ

2.1.1 после второго абзаца дополняется следующим текстом:
«Проверка управляемости самоходных судов должна проводиться согласно Руководству по определению маневренных характеристик судов внутреннего плавания (для Европейских внутренних водных путей).».

2.4 БАЛЛЕР РУЛЯ И ПОВОРОТНОЙ НАСАДКИ

Вводится новый пункт **2.4.10** следующего содержания:
«**2.4.10** Уплотнения баллеров рулей должны быть спроектированы таким образом, чтобы исключить возможность утечки смазочных веществ и загрязнение воды.».

2.9 ПРИВОДЫ РУЛЕВЫХ УСТРОЙСТВ

2.9.1 дополняется следующим текстом:
«Если рулевое устройство оснащено двумя механическими приводами, то оно должно иметь не менее двух источников питания.».

2.9.10 дополняется следующим текстом:
«Штурвал ручного привода не должен приводиться в действие механическим приводом.».

5.4 УСТРОЙСТВА ДЛЯ СЦЕПЛЕНИЯ ТОЛКАЕМЫХ БАРЖ МЕЖДУ СОБОЙ, С ТОЛКАЧАМИ И ГРУЗОВЫМИ СУДАМИ-ТОЛКАЧАМИ

5.4.1.2 В первом абзаце перед словом «судов» дополняется словом «всех».

5.4.2 Силы сцепления и размеры элементов счального устройства.
Название пункта заменяется следующим текстом:
«5.4.2 Силы, действующие на счальное устройство, и определение размеров элементов счального устройства.».

Рис. 5.4.2 На верхних двух рисунках условные обозначения h'_K заменяются H'_K.

5.4.2.1 Первый абзац заменяется следующим текстом:
«Размеры продольных соединительных элементов счальных устройств, указанных в 5.4.1.1, для составов и групп судов, допускаемых к применению, рассчитываются с учетом достаточного запаса прочности и сил, действующих на сцепное устройство, в кН, которые должны приниматься как силы растяжения и определяться по следующим формулам:».

5.4.2.1.1 В формуле (5.4.2.1-1) коэффициент C_P заменяется числом 270.

5.4.2.1.2 В формуле (5.4.2.1-2) коэффициент C_{PB} заменяется числом 80.

5.4.2.1.3 В формуле (5.4.2.1-3) коэффициент C_{PB} заменяется числом 80.

Пояснения к формулам (5.4.2.1-1) – (5.4.2.1-3) заменяются следующим текстом:

«где F_{SB}, F_{SF}, F_{SL} – силы, действующие на счальное устройство в продольном направлении;

270 и 80 – эмпирические установленные значения для перевода установленной мощности в тяговую мощность, обеспечивающие достаточный запас прочности, кН/кВт;

P_B - установленная мощность силовых установок, кВт;

L_S – расстояние между кормой толкача или толкающего судна и узлом сцепления, м;

L'_S – расстояние между кормой толкающего судна и узлом сцепления, расположенным между первым толкаемым судном и сцепленными судами, расположенными непосредственно перед ним, м;

H_k и H'_k - соответствующее плечо рычага продольной связи, м;

B_S - ширина толкающего судна.»

После пояснений к формулам (5.4.2.1-1) - (5.4.2.1-3) дополняется следующим текстом:
«Значение, равное 1200 кН, считается достаточным для максимальной силы сцепления толкающего судна в узле сцепления, расположенном между первым толкаемым судном и судном, присоединенным впереди него, даже если формула (5.4.2.1-3) дает большее значение.».

5.4.2.4 Начало пункта дополняется следующим текстом:
«**5.4.2.4** Разрывное усилие троса должно выбираться в соответствии с предусмотренным количеством витков, накладываемых на кнехты и аналогичное оборудование.», и далее по тексту.

5.4.2.5 заменяется следующим текстом:
«**5.4.2.5** В случае использования толкачей, предназначенных для толкания одной баржи, которым разрешено толкать несколько барж, для определения расчетной силы сцепления может быть использована формула (5.4.2.1-2).».

5.4.2.6 заменяется следующим текстом:
«**5.4.2.6** Должно быть предусмотрено достаточное количество швартовных кнехтов или другого аналогичного оборудования для сцепки судов; эти кнехты или аналогичное оборудование должны выдерживать возникающие силы сцепления.».

5.4.3.1 Слова «испытаний с использованием жесткого соединения» заменяются словами «навигационных испытаний жестко счаленного состава».
Дополняется следующим текстом:
«В целях определения пригодности толкача или самоходного судна для приведения в движение жесткого состава должны быть проведены ходовые испытания состава требуемой комплектации, которая считается наименее благоприятной, согласно Руководству по определению маневренных характеристик судов внутреннего плавания (для Европейских внутренних водных путей).».

8 СПАСАТЕЛЬНЫЕ СРЕДСТВА

Вводится новая глава **8.8** следующего содержания:

«8.8 ВНУТРИСУДОВЫЕ СРЕДСТВА СВЯЗИ, АВРАЛЬНАЯ СИГНАЛИЗАЦИЯ И СИСТЕМА ГРОМКОГОВОРЯЩЕЙ СВЯЗИ

8.8.1 Все пассажирские суда должны быть оборудованы внутрисудовыми средствами связи. Такие средства связи должны быть предусмотрены в служебных помещениях, а также в местах сбора и эвакуации пассажиров, в которых нет прямой переговорной связи с рулевой рубкой.

8.8.2 На судах должна быть предусмотрена система авральной сигнализации.
Система авральной сигнализации должна включать:

.1 систему аврального оповещения командного состава и экипажа судна пассажирами, членами экипажа или обслуживающим персоналом на борту судна.

Эти сигналы тревоги должны подаваться только в помещения, отведенные для командного состава и экипажа судна; их отключение может быть произведено только командным составом.

Возможность включения сигнала тревоги должна быть обеспечена, по меньшей мере, из следующих мест:

из каждой каюты;

из коридоров, лифтов и шахт трапов; при этом расстояние до ближайшего включателя оповещения не должно превышать 10 м, причем каждый водонепроницаемый отсек должен быть оснащен не менее чем одним включателем;

из салонов, столовых и аналогичных помещений, предназначенных для отдыха;

из туалетов, предназначенных для лиц с ограниченной способностью к передвижению;

из машинных отделений, камбузов и аналогичных пожароопасных помещений;
из холодильных камер и других кладовых помещений.

Включатели аврального оповещения должны быть расположены на высоте 0,85 - 1,1 м над полом;

.2 систему аврального оповещения пассажиров командным составом судна.

Эти сигналы тревоги должны быть четко слышимы и безошибочно различимы во всех помещениях, доступных для пассажиров. Должна быть предусмотрена возможность их включения из рулевой рубки и из мест, где постоянно находятся члены экипажа или персонал;

.3 систему аврального оповещения экипажа судна и обслуживающего персонала командным составом судна.

8.8.3 В дополнение к требованиям 8.8.1 и 8.8.2 суда должны быть оборудованы системой громкоговорящей связи.

Системы громкоговорящей связи должна иметь мощность, достаточную для того, чтобы передаваемая информация была слышна во всех помещениях для пассажиров и четко различима на фоне обычного шума.

Если возможна прямая связь между рулевой рубкой и помещениями и местами для пассажиров, то нет необходимости устанавливать громкоговорители.».

9.2 БОРТОВЫЕ ИЛЛЮМИНАТОРЫ, ОКНА И ПАЛУБНЫЕ ИЛЛЮМИНАТОРЫ

9.2.7 после слов «при условии,» заменяется следующим текстом:
«что они не открывающегося типа, имеют повышенную прочность, стекла окон закаленные, а окна соответствуют требованиям стандартов, признанных Регистром.».

9.4 ЗАКРЫТИЯ ГРУЗОВЫХ ТРЮМОВ, ПРИСПОСОБЛЕННЫХ ДЛЯ ПЕРЕВОЗКИ ЖИДКИХ ГРУЗОВ НАЛИВОМ

Вводятся новые пункты **9.4.5 - 9.4.12** следующего содержания:
«**9.4.5** Крышки люков, составные части которых весят более 40 кг, должны быть сдвижными или поворотными для открывания трюмов, или оборудованы механическими открывающими устройствами.
9.4.6 Крышки люков, для подъема и опускания которых используют подъемные устройства, должны быть оборудованы в легкодоступных местах соответствующими устройствами для крепления. На невзаимозаменяемых крышках люков и верхних опорных поверхностях должна быть нанесена маркировка, указывающая на то, каким люкам они соответствуют, и их правильное положение на этих люках.
9.4.7 Необходимо обеспечить надежное крепление крышек люков в рабочем положении.
9.4.8 Для сдвигаемых крышек люков должна быть обеспечена возможность их блокировки в крайних положениях; они должны быть оборудованы стопорами, препятствующими их непреднамеренному горизонтальному смещению не более чем на 0,4 м.

Должны быть предусмотрены соответствующие приспособления для закрепления уложенных друг на друга крышек в требуемом положении.
9.4.9 Подача питания для привода механизированных крышек люка должна автоматически прекращаться при отключении поста управления.
9.4.10 Крышки люков должны выдерживать нагрузку, для которой они предназначены.

Крышки люков, используемые для проходов, должны выдерживать совокупный вес не менее чем 75 кг.
9.4.11 Крышки люков, не используемые для проходов, должны быть соответствующим образом промаркированы.

На крышках люков, которые предназначены для размещения палубного груза, должна быть указана допускаемая нагрузка в т/м^2.
9.4.12 Если для размещения максимально допустимой нагрузки требуется установка опорных стоек, то необходимо указать место их установки; в этом случае на борту судна должны находиться соответствующие схемы установки.».

9.5 ЗАКРЫТИЯ ГРУЗОВЫХ ЛЮКОВ СУХОГРУЗНЫХ ТРЮМОВ

Вводится новый пункт **9.5.10** следующего содержания:
«**9.5.10** На крышки люков сухогрузных трюмов распространяются требования 9.4.5, 9.4.6, 9.4.8, 9.4.9, 9.4.11 и 9.4.12.».

10 РАЗЛИЧНЫЕ УСТРОЙСТВА И ОБОРУДОВАНИЕ

Вводится новая глава **10.11** следующего содержания:

«10.11 НИЗКОРАСПОЛОЖЕННОЕ ОСВЕЩЕНИЕ (НРО) НА ПАССАЖИРСКИХ И ВЫСОКОСКОРОСТНЫХ СУДАХ

10.11.1 Дополнительно к аварийному освещению пути эвакуации, включая трапы, лестничные пролеты, выходы и аварийные выходы, на пассажирских и высокоскоростных судах должны быть оборудованы низкорасположенным освещением (НРО).

10.11.2 НРО должно функционировать в течение, по крайней мере, 30 мин после его включения.

10.11.3 От НРО не должно исходить никакого радиоактивного, а также токсичного излучения.

10.11.4 Инструкции по НРО должны быть вывешены в каждой каюте.

10.11.5 Предусматриваются следующие системы НРО:
.1 фотолюминесцентная система, использующая фотолюминесцентный материал, содержащий химическое вещество (например, сульфид цинка), которое обладает свойством накапливать энергию при освещении его видимым светом. Фотолюминесцентный материал излучает свет, становящийся видимым, когда источник окружающего света утрачивает эффективность. Без подпитывающего источника света фотолюминесцентный материал в течение определенного времени возвращает накопленную энергию с уменьшающейся фотометрической яркостью;
.2 системы с электрическим питанием, использующие лампы накаливания, светоизлучающие диоды, электролюминесцентные полосы или диоды, электрофлюоресцентные лампы и т. д.

10.11.6 Во всех проходах НРО должно быть непрерывным для обеспечения видимого очертания пути выхода, за исключением разрывов, образованных коридорами и дверями кают.
НРО должно быть установлено, по крайней мере, на одной стороне коридора, либо на переборке не выше 300 мм от палубы, либо на палубе в пределах 150 мм от переборки. В коридорах шириной более 2 м НРО должно быть установлено с обеих сторон.

10.11.7 В тупиках коридоров НРО должно иметь стрелки, расположенные на расстоянии не более чем 1 м, или эквивалентные указатели направления, ориентированные в направлении пути выхода из тупика.

10.11.8 На всех трапах НРО должно быть расположено, по крайней мере, на одной стороне на высоте не более чем 300 мм над ступеньками, что сделает каждую ступеньку легко видимой любому человеку, стоящему выше или ниже этой ступеньки.
НРО должно располагаться на каждой стороне трапа, если его ширина составляет 2 м и более. Верхняя и нижняя ступеньки трапа должны быть обозначены, чтобы показать, что ступенек больше нет.

10.11.9 НРО должно указывать на ручку двери выхода. Никакие другие двери не должны обозначаться подобным образом.

10.11.10 Если в выгородках или переборках установлены двери скользящего типа, направление их открывания должно быть обозначено НРО.

10.11.11 Все знаки путей эвакуации должны быть изготовлены из фотолюминесцентного материала или отмечены электрическим освещением. Размеры таких знаков и отметок должны быть соизмеримы с остальным НРО.

10.11.12 Знаком выхода НРО должны быть снабжены все выходы. Знаки должны располагаться в пределах установленной зоны на стороне расположения ручки дверей выхода.

10.11.13 Цвет знаков должен быть контрастным по отношению к фону (переборке или палубе), на который они наносятся.

10.11.14 Для знаков НРО должны быть использованы стандартные символы (например, изображенные в Резолюции ИМО А.760(18)).

10.11.15 Полосы фотолюминесцентного материала должны быть шириной не менее 75 мм. Полосы меньшей ширины могут быть использованы, если их яркость увеличена для компенсации уменьшения ширины.

10.11.16 Фотолюминесцентный материал должен обеспечивать яркость, по крайней мере, 15 мкд/м^2, измеренную через 10 мин после устранения всех внешних источников освещения. Затем система должна обеспечивать яркость более 2 мкд/м^2 в течение 20 мин.

10.11.17 Материалы любой фотолюминесцентной системы должны быть обеспечены не менее чем минимальным уровнем внешнего освещения для зарядки фотолюминесцентного материала, чтобы соответствовать требованиям яркости, указанным в 10.11.16.

10.11.18 НРО, работающее от электричества, должно быть присоединено к аварийному распределительному щиту, так чтобы питаться от основного источника электрической энергии в обычных условиях и от аварийного источника электрической энергии, когда он включается.

10.11.19 НРО, работающее от электричества, должно либо включаться автоматически, либо включаться одним действием с поста в рулевой рубке.

10.11.20 При применении НРО, работающего от электричества, на него распространяются следующие стандарты яркости:
.1 активные компоненты систем должны иметь минимальную яркость 10 кд/м^2;
.2 точечные источники света миниатюрных ламп накаливания должны обеспечивать не менее 150 мкд средней сферической интенсивности при расстоянии между лампами не более чем 0,1 м;
.3 точечные источники света систем светоизлучающих диодов должны иметь минимальную пиковую интенсивность 35 мкд. Угол конуса полуинтенсивности должен быть соответствующим для вероятных направлений движения при приближении и обзоре. Расстояние между светодиодными лампами не должно превышать 0,3 м;
.4 электролюминесцентные системы должны действовать в течение 30 мин с момента прекращения подачи питания от основного источника электроэнергии, к которому их требуется подключить согласно 10.11.18.

10.11.21 Все НРО, работающее от электричества, должно быть устроены так, чтобы отказ любого отдельного огня, светящейся полосы или батареи не был результатом неэффективности световых разметок.».

ЧАСТЬ IV. ОСТОЙЧИВОСТЬ, ДЕЛЕНИЕ НА ОТСЕКИ И НАДВОДНЫЙ БОРТ

3.10 Название главы заменяется следующим текстом:
«**3.10 СУДА С СОСТАВНЫМ КОРПУСОМ**».

Вводятся новые пункты **3.10.2** – **3.10.6** следующего содержания:

«**3.10.2** При обеспечении требуемых запасов плавучести, посадки и остойчивости отделившихся частей судна следует предполагать, что обе части были предварительно разгружены, или что контейнеры, выступающие за комингсы люков, были соответствующим образом закреплены во избежание соскальзывания.

3.10.3 Для каждой из двух частей при проверке условий 3.3.6 должны выполняться следующие требования:

метацентрическая высота *h* должна составлять не менее 0,5 м;

остаточное расстояние безопасности должно составлять не менее 0,1 м;

скорость принимается равной 7 км/ч;

давление ветра должно приниматься равным 0,01 т/м^2.

3.10.4 Для отделившихся частей судна не требуется выдерживать угол крена (≤ 5°), так как этот угол регламентирован при перевозке незакрепленных контейнеров.
Плечо кренящего момента, возникающее при наличии свободных поверхностей жидкостей, должно определяться в соответствии с 3.3.5.5.

3.10.5 Требования, приведенные в 3.10.3 и 3.10.4, также считаются выполненными, если для каждой из двух частей судна выполнены требования к остойчивости, указанные в 9.1.0.95.2 Положения о перевозке опасных грузов по Рейну (ADNR).

3.10.6 Проверка остойчивости отделившихся частей судна может проводиться в предположении, что груз равномерно распределен, поскольку это может быть выполнено до разъединения судна, либо в предположении, что судно в значительной степени разгружено.».

ЧАСТЬ V. ПРОТИВОПОЖАРНАЯ ЗАЩИТА

3.3 СУДОВЫЕ БЫТОВЫЕ УСТАНОВКИ, РАБОТАЮЩИЕ НА СЖИЖЕННОМ ГАЗЕ

3.3.1.1 заменяется следующим текстом:

«**3.3.1.1** Требования настоящей главы применяются к стационарным установкам, состоящим, в общем виде, из одного или нескольких сосудов для газа, одного или нескольких регуляторов давления, распределительной сети, потребляющих газ приборов и системы обнаружения и сигнализации о взрывоопасной концентрации газа.».

3.3.1.5 Первое предложение заменяется следующим текстом:
«Бытовыми установками, работающими на сжиженном газе, не допускается оборудовать

пассажирские суда длиной более 45 м,

маломерные суда с бензиновыми двигателями, предназначенные для перевозки пассажиров.

Пассажирские суда длиной менее 45 м могут быть оборудованы данными установками при условии наличия на борту системы обнаружения и сигнализации о взрывоопасной концентрации газа, соответствующей требованиям 3.3.6.6.9 настоящей части Правил и 7.7 части IX «Электрическое оборудование».»

Вводится новый пункт **3.3.6.6.9** следующего содержания:
«**.9** на пассажирских судах, указанных в 3.3.1.5, в данном помещении должны быть установлены извещатели системы обнаружения и сигнализации о взрывоопасной концентрации газа. Кроме того, помещение должно быть оборудовано звуковым и визуальным сигнальными устройствами системы, которые должны быть установлены также в помещении ходовой рубки или другом помещении с постоянной вахтой. Щиты управления и индикации системы должны располагаться за пределами данных помещений, а также помещений для хранения сосудов с газом.».

4.2 СТАНЦИИ ПОЖАРОТУШЕНИЯ

4.2.9 Второй абзац исключается.

Вводится новый пункт **4.2.11** следующего содержания:
«**4.2.11** В случае, если оборудование систем пожаротушения располагается вне станции пожаротушения, при его размещении должны выполняться следующие условия:
.1 резервуары, арматура и трубопроводы систем объёмного пожаротушения, находящиеся под высоким давлением, не должны располагаться в жилых помещениях;

.2 температура в шкафах и помещениях для хранения резервуаров высокого давления не должна превышать 50 ^{0}C;
.3 шкафы и помещения для хранения резервуаров высокого давления, находящиеся на палубе, должны быть прочно закреплены и снабжены вентиляционными отверстиями, расположенными таким образом, чтобы в случае нарушения герметичности резервуара выходящий газ не мог проникнуть внутрь судна. Наличие прямого сообщения этих помещений с другими помещениями судна не допускается;
.4 пусковые устройства систем пожаротушения должны быть обозначены специальной табличкой, содержащей символ и надпись, выполненную красными буквами на белом фоне, указывающую на наличие установки пожаротушения. Табличка должна располагаться на видном месте и иметь размер боковой стороны не менее 10 см. Рядом с пусковым устройством должна быть вывешена инструкция, указанная в 4.2.9.».

4.5 СИСТЕМЫ ГАЗОВОГО ПОЖАРОТУШЕНИЯ

4.5.1 Первый абзац заменяется следующим текстом:
«Для защиты помещений, указанных в табл. 4.1.7, должны применяться системы газового пожаротушения с использованием в качестве огнетушащего вещества углекислого газа (CO_2), галлона HFC 227ea (FM-200), IG-541 (ИНЕРГЕН).».

Водится новый пункт **4.5.2** следующего содержания:
«**4.5.2** Если система пожаротушения предназначена для защиты нескольких помещений, минимальный запас огнетушащего вещества должен соответствовать количеству, необходимому для тушения пожара в помещении наибольшего объёма.».

Текст существующего пункта **4.5.2** переносится в начало пункта **4.5.3**.

4.5.5 Текст первого предложения, а также слова «При этом» из второго предложения исключаются.

4.5.27.5 дополняется следующим текстом:
«При воздействии на баллон огня, в случае, когда система пожаротушения оказалась не приведённой в действие, выпуск огнетушащего вещества в защищаемое помещение должен обеспечиваться автоматически.».

4.6 СПРИНКЛЕРНАЯ СИСТЕМА

4.6.2.2 дополняется следующим текстом:
«На случай отказа насоса спринклерной системы должна быть предусмотрена возможность подачи указанного выше количества воды другим насосом, находящимся на борту.».

4.6.2.6 Первый абзац заменяется следующим текстом:
«Насос и контрольно-сигнальные устройства должны приводиться в действие не менее чем от двух независимых источников энергии, расположенных в разных помещениях, каждый из которых обеспечивает их работу.».

4.6.6.1 «200» заменяется на «50».

4.7 СИСТЕМЫ ПОЖАРОТУШЕНИЯ ДЛЯ СУДОВ, ПЕРЕВОЗЯЩИХ ОПАСНЫЕ ГРУЗЫ

4.7.1.1 - 4.7.1.4 заменяются следующим текстом:
«**.1** углекислый газ (CO_2);
.2 галлон HFC 227ea (FM-200);
.3 IG-541 (ИНЕРГЕН);
.4 FK-5-1-12 (Novec 1230).», и далее по тексту.

4.7.5 заменяется следующим текстом:
«**4.7.5** Системы пожаротушения с использованием галлона HFC-227ea должны соответствовать 4.5.27 и, дополнительно, следующим требованиям:

.1 при расчёте системы должно обеспечиваться, чтобы после выпуска огнетушащего вещества его концентрация в защищаемом помещении не превышала 10,5 % по объёму;
.2 при отсутствии в рулевой рубке сигнализации, согласно 4.5.27.4, аварийный сигнал должен подаваться снаружи защищаемого помещения.».

4.7.6 заменяется следующим текстом:
«**4.7.6** Системы пожаротушения с использованием галлона IG-541 должны соответствовать требованиям 4.5.28.
При этом давление наполнения резервуаров не должно превышать 200 кг/см^2 при температуре +15 ^{0}С.».

Вводится новый пункт **4.7.7** следующего содержания:
«**4.7.7** Системы пожаротушения с использованием огнетушащего вещества FK-5-1-12 должны соответствовать применимым требованиям 4.5.27 (в частности 4.5.27.1, 4.5.27.5), а также 4.7.5.2 и следующим дополнительным требованиям:
.1 степень наполнения резервуаров не должна превышать 1 кг/л. При этом удельный объём FK-5-1-12 принимается 0,0719 м^3/кг;
.2 объём FK-5-1-12, подаваемый в защищаемое помещение, должен составлять не менее 5,5 % от объёма этого помещения. Выпуск этого количества должен осуществляться за 10 с;
.3 после выпуска огнетушащего вещества его концентрация в защищаемом помещении не должна превышать 10 %.».

5 СИСТЕМЫ ПОЖАРНОЙ СИГНАЛИЗАЦИИ

5.7 дополняется следующим текстом:
«В непосредственной близости от приёмной станции должна быть в наличии информация о расположении противопожарных зон, оборудованных данной сигнализацией.».

5.10 заменяется следующим текстом:
«**5.10** Извещатели системы должны быть сгруппированы по зонам пожарной сигнализации.
В случае если система не обладает способностью дистанционного определения извещателей, каждая зона пожарной сигнализации должна включать в себя не более 50 изолированных помещений, расположенных на одной палубе, и должна обслуживаться одним лучом. Это требование не распространяется на выгородки трапов и шахты лифтов.
На пассажирских судах зона пожарной сигнализации не должна выходить за пределы главной вертикальной зоны.
Камбузы, машинные и котельные отделения должны рассматриваться как отдельные зоны пожарной сигнализации.».

5.11 заменяется следующим текстом:
«**5.11** В системе должны применяться тепловые, дымовые или ионные извещатели одобренного типа. Другие виды извещателей могут применяться только в качестве дополнительных.

Извещатели должны устанавливаться в верхней части каждого защищаемого помещения на расстоянии не менее 0,5 м от переборки, с учётом расположения корпусных конструкций, вентиляционных каналов и прочего оборудования, способного вызвать нарушение их работы.

Количество извещателей и расстояния между ними должны определяться с учётом характеристик извещателя, конфигурации и размеров помещения и соответствовать табл. 5.11:

Таблица 5.11

Тип извещателя	Максимальная площадь палубы, обслуживаемая извещателем	Максимальное расстояние между извещателями	Максимальное расстояние между извещателем и переборкой
Тепловой	37 м²	9 м	4,5 м
Дымовой	74 м²	11 м	5,5 м

Регистром могут быть допущены другие расстояния на основании проведенных испытаний, подтверждающих соответствующие характеристики извещателей.

5.15 заменяется следующим текстом:
«**5.15** Срабатывание извещателя пожарной сигнализации должно приводить к возникновению визуального и звукового сигнала на панели управления, а также срабатыванию сигнальных устройств, расположенных в месте с постоянной вахтой.».

ЧАСТЬ VI. МЕХАНИЧЕСКИЕ УСТАНОВКИ

Изменения к указанной части Правил, внесенные циркулярным письмом № 007-2.2-463ц от 11.03.2010 г., аннулируются и заменяются следующими изменениями и дополнениями.

2.1 МОЩНОСТЬ ГЛАВНЫХ МЕХАНИЗМОВ

2.1.1 заменяется следующим текстом:
«**2.1.1** Мощность главных механизмов должна обеспечивать скорость судна в грузу относительно воды (или судна-толкача с груженым составом) не менее 13 км/ч на тихой воде. Требование не распространяется на суда-толкачи без состава, а также на суда и составы судов, которые эксплуатируются исключительно в акваториях рейда или порта.
Требуемая скорость хода должна подтверждаться испытаниями при условиях, изложенных в 2.1.2.
Если при испытаниях судна порожнем была подтверждена способность развивать скорость более 40 км/ч относительно воды, в судовых документах должна быть сделана соответствующая запись.».

2.1.3 заменяется следующим текстом:
«**2.1.3** Механическая установка судна (или судна-толкача с груженым составом) должна обеспечивать при установившемся свободном заднем ходе не менее 70 % расчетной частоты вращения механизмов переднего хода в течение не менее 30 мин.
Мощность заднего хода должна обеспечивать торможение судна в пределах приемлемого времени при движении вниз по течению с сохранением в то же время удовлетворительной маневренности. Для судов (или составов) длиной менее 86 м и шириной менее 22,9 м способность торможения может быть заменена способностью приемлемой поворотливости. Под приемлемым временем понимается согласованное между проектантом и заказчиком время, при котором длина выбега судна находится в пределах удовлетворительного расстояния с учетом его размеров, назначения, конструкции и условий эксплуатации.
Способность торможения (относительно берега) должна быть подтверждена испытаниями при движении по течению со скоростью в начале торможения 13 км/ч относительно воды при глубине под килем не менее 20 % величины осадки, но не менее 0,5 м.
Условия проведения испытаний для обеспечения требований 2.1.1 – 2.1.3 изложены в Руководстве по определению маневренных характеристик судов внутреннего плавания (для Европейских внутренних водных путей).».

2.5 ВИБРАЦИЯ И ШУМ

2.5.2 заменяется следующим текстом:
«**2.5.2** Максимально допустимые уровни звукового давления приведены в приложении 1 к настоящему разделу Правил.
Измерения шума должны выполняться на головных судах серии, судах единичной постройки, а также в случае значительного переоборудования судна. Требования к проведению измерений шума приведены в приложении 2 к настоящему разделу.».

Вводятся новые приложения 1 и 2 следующего содержания:

«ПРИЛОЖЕНИЕ 1. НОРМЫ ШУМА

Нормы шума, максимально допустимые уровни звукового давления и меры по их снижению, приведенные ниже, соответствуют требованиям Директивы 2006/87/ЕС (Приложение II к Директиве).

1. Максимально допустимый уровень звукового давления для машинных помещений – 110 дБ(А). Точки выполнения замеров выбираются в зависимости от мест, необходимых для обслуживания механизмов, расположенных в этих помещениях при нормальной работе механической установки.
2. При нормальных условиях эксплуатации уровень звукового давления, создаваемый судном и измеренный на ходовом мостике на уровне головы рулевого на его рабочем месте, не должен превышать 70 дБ(А).
3. Уровень звукового давления для сигнала тревоги в жилых помещениях должен быть не менее 75 дБ(А). В машинных помещениях и насосных отделениях звуковой сигнал должен сопровождаться мигающим световым сигналом, видимым из любой части помещения
4. Уровень звукового давления, создаваемый судном на ходу, не должен превышать 75 дБ(А) на расстоянии 25 м перпендикулярно каждому борту судна. При этом должны быть предусмотрены меры по снижению шума от работы главного двигателя с установкой глушителей на воздухозаборных и выхлопных трактах. За исключением погрузочных операций, шум, производимый неподвижным судном, не должен превышать 65 дБ(А) на расстоянии 25 м перпендикулярно каждому борту. Превышение допускается для любого плавучего сооружения при работе его рабочих механизмов.
5. Для членов экипажа, которые могут ежедневно посещать помещения, где уровень шума превышает 85 дБ(А), должны быть предусмотрены индивидуальные средства защиты от шума. В рабочих пространствах, где уровень шума превышает 90 дБ(А), должны быть размещены надписи, что применение индивидуальных акустических средств защиты диаметром не менее 10 см обязательно (см. рис.).

6. Жилые помещения должны быть защищены от повышенного шума и вибрации. Уровень звукового давления не должен превышать следующих значений:
70 дБ(А) в общих жилых помещениях;
60 дБ(А) в помещениях со спальными местами (требование не распространяется на суда, эксплуатирующиеся в периоды, не требующие отдыха экипажа в соответствии с действующим законодательством. При этом ограничение продолжительности времени эксплуатации в сутки должно быть отражена в судовых документах).
7. Плавучее сооружение, при работе которого на нем присутствует персонал, должно иметь общую систему звуковой предупредительной сигнализации, по звуку отличающуюся от всех других сигналов и превышающую по уровню звукового давления все сигналы в жилых и рабочих помещениях минимум на 5 дБ(А). Должна быть предусмотрена возможность включения общей сигнализации с ходового мостика и главного рабочего поста управления.

ПРИЛОЖЕНИЕ 2. ИЗМЕРЕНИЯ ШУМА

1. Общие положения

Измерения уровней шума производятся по одобренной программе с учетом требований 2.5 и Приложения 1.

Измеренные уровни шума не должны превышать указанные в Приложении 1 допускаемые значения. В противном случае должны быть разработаны и приняты меры по их снижению.

Результаты измерений оформляются в соответствии с требованиями, изложенными в настоящем Приложении.

2. Измерительные приборы

Измерительные приборы должны соответствовать требованиям класса 1 согласно Стандарту EN 60651:1994.

До и после каждой серии измерений, для калибрования измерительной системы, микрофон должен быть откалиброван калибратором класса 1, соответствующим стандарту EN 60942:1998. Соответствие калибратора требованиям стандарта EN 60942:1998 должно проверяться раз в год. Соответствие измерительного оборудования требованиям стандарта EN 60651:1994 должно проверяться раз в два года.

3. Измерение уровня шума

3.1. На борту судна / плавучего сооружения.*

Измерения должны проводиться в соответствии со стандартом ИСО 2923:2003, разделы 5 – 8 для измерения только А- взвешенных уровней звукового давления.

3.2. Шум, производимый плавучим сооружением.

Уровень шума, производимого судном / плавучим сооружением* на внутренних водных путях и в портах, определяется посредством измерений в соответствии со стандартом EN ISO 22922: 2000, разделы 7 – 11. Во время проведения измерений двери и окна машинных отделений должны быть закрыты.

4. Документация

Измерения должны быть зарегистрированы согласно Акту о замере уровня шума:

Акт о замере уровня шума (рекомендуемая форма)

на борту судна в соответствии с ИСО 2923:2003.
уровень шума, производимого судном / плавучим сооружением*, в соответствии со стандартом EN ISO 22922: 2000 (*)

А. Данные о судне / плавучем сооружении.

1. Тип и название судна / плавучего сооружения*:
   Индивидуальный Европейский идентификационный номер:
2. Владелец:
3. Тип ГЭУ:

3.1. Главные двигатели:

Номер	Производитель	Тип	Год постройки	Мощность (кВт)	Частота вращения (мин$^{-1}$)	Двухтактный/ четырехтактный	Турбонаддув да/ нет
1							
2							

3.2. Главный редуктор / трансмиссия*
Производитель: … Тип: … Редуктор: 1: …
3.3. Движители
Тип:
Количество: … Количество лопастей: … Диаметр: … мм … Насадки: да/ нет (*)
3.4. Рулевое устройство
Тип:
4. Вспомогательные механизмы:

Количество	Приведение в движение (чего)	Производитель	Тип	Год постройки	Мощность (кВт)	Частота вращения (мин$^{-1}$)
1						
2						
3						
4						
5						

5. Меры, принятые для уменьшения уровня шума:
6. Дополнительные сведения:

В. Сведения об измерительных приборах:

1. Измеритель уровня звукового давления:
Производитель: … Тип: … Последняя проверка: …
2. Анализатор октавной/ треть-октавной полосы частот*:
Производитель: … Тип: … Последняя проверка: …
3. Калибратор:
Производитель: … Тип: … Последняя проверка: …
4. Принадлежности и приспособления:
5. Дополнительные сведения:

С. Условия измерений на борту судна

1. Состояние судна и механизмов во время измерений:
2. Состояние загрузки/ водоизмещение: … т/ $м^3$ (*) (приблизительно … % от максимального значения).
3. Частота вращения главного двигателя: … $мин^{-1}$ (приблизительно … % от максимального значения).
4. Работающие вспомогательные механизмы (количество, какие):
5. Дополнительные сведения:

D. Условия проведения измерений шума, производимого судном (вне судна)

1. Район измерений: … (вверх/ вниз по течению) (*)
2. Глубина воды: … м (относительный водный уровень = … м)
3. Погодные условия: … Температура: …°С; Сила ветра: … (по шкале Бофорта)
4. Наличие внешних шумов: да/ нет (*), если имеется, укажите, какое…
5. Дополнительные сведения:

Е. Записи о выполнении измерений

1. Измерение проведено (кем): …
2. Дата:
3. Дополнительные сведения:
4. Подпись:

F. Результаты измерений

1. Измерения уровня шума на борту судна:

Номер	Точка измерений	Двери		Окна		Измеренное значение в дБ(А)	Наблюдения
		открыты	закрыты	открыты	закрыты		

2. Измерения уровня шума, производимого судном:

Номер	Точка измерений	Измеренное значение в дБ(А)	Наблюдения

(*) Ненужное зачеркнуть

3.2 ПОСТЫ УПРАВЛЕНИЯ

Вводится новый пункт **3.2.9** следующего содержания:
«**3.2.9** Устройства управления носовым подруливающим устройством должны быть установлены на ходовом мостике.».

4.1 ОБЩИЕ ПОЛОЖЕНИЯ

Вводится новый пункт **4.1.3** следующего содержания:
«**4.1.3** Если для обеспечения управляемости судна обязательно применение подруливающего устройства, его помещение рассматривается как главное машинное отделение применительно к уровню льяльных вод.».

ЧАСТЬ VII. СИСТЕМЫ И ТРУБОПРОВОДЫ

6.11 ОСУШЕНИЕ ГРУЗОВЫХ ПОМЕЩЕНИЙ, ПРЕДНАЗНАЧЕННЫХ ДЛЯ ПЕРЕВОЗКИ ОПАСНЫХ ГРУЗОВ

Вводятся новые пункты **6.11.8** и **6.11.9** следующего содержания:
«**6.11.8** Осушительные насосы для помещений, расположенных в пределах грузового пространства, должны быть установлены в пределах этого пространства за исключением:
междубортовых и междудонных пространств, не имеющих общей перегородки с грузовыми танками;
коффердамов и трюмных помещений, если прием балласта производится при помощи трубопровода системы пожаротушения, расположенного в грузовом пространстве.
В тех случаях, когда междудонное пространство используется в качестве топливной цистерны, оно не должно быть соединено с системой осушительных трубопроводов.

6.11.9 Насосное отделение, расположенное под палубой, должно осушаться в чрезвычайной ситуации с помощью системы, находящейся в пределах грузового пространства и не зависящей от любой другой системы. Эта система должна располагаться за пределами насосного отделения.».

7 БАЛЛАСТНАЯ, КРЕНОВАЯ И ДИФЕРЕНТНАЯ СИСТЕМЫ

Вводится новая глава **7.4** следующего содержания:
«7.4 ТРЕБОВАНИЯ К СУДАМ ТИПОВ G, C, N, ПЕРЕВОЗЯЩИМ ОПАСНЫЕ ГРУЗЫ

7.4.1 Балластные насосы для помещений, расположенных в пределах грузового пространства, должны быть установлены в пределах этого пространства за исключением:
междубортовых и междудонных пространств, не имеющих общей перегородки с грузовыми танками;
коффердамов и трюмных помещений, если прием балласта производится при помощи трубопровода системы пожаротушения, расположенного в грузовом пространстве.

7.4.2 В тех случаях, когда балластный насос установлен в грузовом пространстве, напорная труба и ее бортовой всасывающий патрубок для забора водяного балласта должны быть расположены в пределах грузового пространства.».

9.2 ГАЗООТВОДНАЯ СИСТЕМА НЕФТЕНАЛИВНЫХ И КОМБИНИРОВАННЫХ СУДОВ

Вводится новый пункт **9.2.5** следующего содержания:
«**9.2.5** Выпускные отверстия клапанов повышенного давления должны находиться на высоте не менее 2 м над уровнем палубы и на расстоянии не менее 6 м от жилых и служебных помещений, расположенных за пределами грузового пространства. Указанное значение высоты может быть уменьшено, если в радиусе 1 м от отверстия клапана повышенного давления не расположено какое-либо оборудование и не проводятся какие-либо работы и эта зона обозначена.».

Нумерация существующих пунктов 9.2.5 – 9.2.8 заменяется на 9.2.6 – 9.2.9 соответственно.

10.1 ГАЗОВЫПУСКНЫЕ ТРУБОПРОВОДЫ

Вводится новый пункт **10.1.13** следующего содержания:
«**10.1.13** Для судов, перевозящих опасные грузы, отработавшие газы должны выводиться из судна в атмосферу либо через выхлопную трубу, либо через отверстие в обшивке корпуса.

Выпускное отверстие должно находиться на расстоянии не менее 2 м от грузового пространства (требование к расстоянию не относится к сборщикам льяльных вод и к судам обеспечения). Выхлопные трубы двигателей должны быть расположены таким образом, чтобы отработавшие газы относило от судна. Выхлопные трубы не должны размещаться в пределах грузового пространства.».

12.7 ТОПЛИВНЫЕ ЦИСТЕРНЫ

12.7.1 заменяется следующим текстом:

«12.7.1 Топливные цистерны должны составлять неотъемлемую часть корпуса судна или быть прочно прикреплены к нему. Конструктивные элементы таких цистерн должны соответствовать требованиям части II «Корпус».
Переносные расходные топливные цистерны допускается применять, если они отвечают следующим требованиям:
.1 вместимость цистерн не должна превышать 1000 л;
.2 конструкция цистерны должна предусматривать надёжное крепление и электрическое заземление на корпус;
.3 цистерны должны быть изготовлены из стали, иметь достаточную толщину стенок, и под ними должен быть установлен поддон. Последний должен быть спроектирован так, чтобы не допустить попадания вытекающего топлива в воду. От использования поддона можно отказаться в том случае, если используются танки с двойными стенками и системой защиты от протечек или системой предупреждения о протечке, и которые заполняются только через автоматический подающий клапан.
В случае применение на судне переносных цистерн соответствующая запись должна быть внесена в Судовое свидетельство ЕС после их освидетельствования.».

12.8 ПОДВОД ТОПЛИВА К ДВИГАТЕЛЯМ ВНУТРЕННЕГО СГОРАНИЯ

12.8.7 Ссылка на 2.12 части VIII «Механизмы» заменяется ссылкой на 2.12 части IX «Механизмы» Правил классификации и постройки морских судов.».

19.1 УСТАНОВКИ СЖИЖЕННОГО ГАЗА ДЛЯ БЫТОВЫХ НУЖД

Вводится новый пункт **19.1.1** следующего содержания:

«**19.1.1** Системы сжиженного газа для бытовых нужд могут устанавливаться на грузовых судах в соответствии с требованиями 19.1.2 – 19.1.4. Помимо грузовых судов допускается установка таких систем на пассажирских судах длиной не более 45 м, если в помещениях, где установлено газовое оборудование, предусмотрена система обнаружения и сигнализации о взрывоопасной концентрации газа, соответствующая требованиям 3.3.6.6.9 части V «Противопожарная защита» и 7.7 части IX «Электрическое оборудование».».
Допускается эксплуатация до 2045 года таких систем на существующих пассажирских судах независимо от их длины при условии установки на судне системы обнаружения и сигнализации о взрывоопасной концентрации газа, соответствующей вышеуказанным требованиям.».

Нумерация существующих пунктов **19.1.1** – **19.1.3** заменяется на **19.1.2** – **19.1.4** соответственно.

ЧАСТЬ VIII. МЕХАНИЗМЫ

2.1 ОБЩИЕ ПОЛОЖЕНИЯ

Вводятся новые пункты **2.1.4** и **2.1.5** следующего содержания:
«**2.1.4** Если реверсирование главного двигателя осуществляется сжатым воздухом, система сжатого воздуха должна постоянно поддерживать необходимое давление воздуха при помощи автоматического подкачивающего компрессора или, при поступлении сигнала на ходовой мостик, подкачиваться при помощи вспомогательного двигателя, запускаемого с мостика из

состояния готовности. Должна быть предусмотрена сигнализация минимального уровня топлива в расходной цистерне такого двигателя.

2.1.5 Если имеется расходная цистерна главного двигателя, ее объем должен быть достаточным для обеспечения его работы в течение 24 ч, принимая расход топлива равным 0,25 л/кВт·ч. Должен быть предусмотрен топливный насос для постоянного пополнения расходной цистерны, или должно быть обеспечено его автоматическое включение и выключение при достижении нижнего и верхнего уровня допустимого в топливной цистерне, соответственно.».

6.1 ОБЩИЕ ПОЛОЖЕНИЯ

6.1.8 Текст после слов «за исключением сцепных,» дополняется словами «ваерных и крановых», и далее по тексту.

ЧАСТЬ IX. ЭЛЕКТРИЧЕСКОЕ ОБОРУДОВАНИЕ

6.3 АВАРИЙНОЕ ОСВЕЩЕНИЕ

Название главы заменить следующим:

«**6.3 АВАРИЙНОЕ ОСВЕЩЕНИЕ И НИЗКОРАСПОЛОЕННОЕ ОСВЕЩЕНИЕ С ЭЛЕКТРИЧЕСКИМ ПИТАНИЕМ**»

Вводятся новые пункты **6.3.7 – 6.3.11** следующего содержания:

«**6.3.7** Пассажирские и высокоскоростные суда должны иметь соответствующие системы низкорасположенного освещения, указывающие пути эвакуации и аварийные выходы, в случаях, когда эффективность обычного аварийного освещения снижается из-за дыма.

Система низкорасположенного освещения должна получать питание от АРЩ таким образом, чтобы функционировать как в нормальных условиях, когда работают основные генераторы, так и в аварийных условиях. Система низкорасположенного освещения должна находиться в действии постоянно.

6.3.8 Низкорасположенное освещение должно обеспечивать следующие уровни яркости:

.1 активные части системы должны иметь минимальную яркость 10 кд/м^2;

.2 точечные источники, состоящие из миниатюрных ламп накаливания, должны обеспечивать среднюю сферическую интенсивность не менее 150 мкд при расстоянии между лампами не более 100 мм;

.3 точечные источники, выполненные светоизлучающими диодами, должны иметь минимальную пиковую интенсивность 35 мкд. Угол сферического конуса половинной интенсивности должен соответствовать направлению подхода и обзора наблюдателя. Расстояние между светоизлучающими диодами не должно быть более 300 мм.

6.3.9 Питание системы низкорасположенного освещения должно быть устроено таким образом, чтобы отказ любого источника света и пожар в одной противопожарной зоне или на одной палубе не приводили к выходу из строя освещения и обозначения участков пути эвакуации в другой противопожарной зоне или палубе.

6.3.10 Отказ или повреждение любого источника света не должен приводить к потере видимого очертания пути эвакуации на участке длиной более 1 м.

6.3.11 Степень защиты оболочек источников света должна быть не менее IP55.».

6.6 ОСВЕЩЕННОСТЬ

6.6.1 дополняется следующим текстом:

«Для пассажиров с ограниченной возможностью передвижения по зрению в районах судна, где возможно их нахождения во время рейса, могут потребоваться уровни освещённости, превышающие значения, указанные в табл. 6.6.1.».

7.4 СИГНАЛИЗАЦИЯ ОБНАРУЖЕНИЯ ПОЖАРА

Заменяется следующим текстом:

«7.4 СИГНАЛИЗАЦИЯ ОБНАРУЖЕНИЯ ПОЖАРА

7.4.1 Системы сигнализации обнаружения пожара, устанавливаемые на суда, должны быть одобренного Регистром типа и, кроме требований настоящей главы, отвечать требованиям разд. 5 части V «Противопожарная защита».

7.4.2 Применение извещателей системы сигнализации обнаружения пожара, установленных в помещениях, где могут образоваться взрывоопасные пары, или находящихся в струе воздуха, отсасываемого из этих помещений, регламентируется в 2.9, 19.2 и 19.3.

7.4.3 В системе сигнализации обнаружения пожара должно быть предусмотрено не менее двух источников электрической энергии, один из которых должен быть аварийным. Питание должно осуществляться по отдельным фидерам, предназначенным только для этой цели. При исчезновении питания от основного источника электрической энергии должно быть предусмотрено автоматическое переключение питания на аварийный источник с подачей звукового и светового сигнала.
Если основным источником энергии является аккумуляторная батарея, для питания системы пожарной сигнализации должны быть предусмотрены две отдельные аккумуляторные батареи (основная и резервная), причем емкость каждой из них должна быть достаточной для работы системы сигнализации обнаружения пожара без подзарядки в течение не менее 3 сут.

7.4.4 Система обнаружения дыма путем забора проб воздуха должна получать питание вместе с вентиляторами по отдельным фидерам от основного источника электрической энергии и от аварийного источника или другого независимого от основного источника электрической энергии.

7.4.5 Приемное устройство сигнализации обнаружения пожара, кроме указанной в 7.4.4, должно быть сконструировано таким образом, чтобы:
.1 любой сигнал или повреждение одной цепи не влияли на нормальную работу других цепей;
.2 сигнал обнаружения признаков пожара преобладал над другими сигналами, поступающими на приемное устройство, и позволял определить расположение помещения, из которого поступил сигнал обнаружения признаков пожара;
.3 цепи контактных извещателей сигнализации обнаружения признаков пожара работали на размыкание. Допускается применение контактных извещателей, работающих на замыкание, если они имеют герметизированные контакты, а цепь их непрерывно контролируется для обнаружения повреждения;
.4 имелась возможность контроля его работы.

7.4.6 Приемное устройство сигнализации должно давать сведения, указанные в табл. 7.4.6.
Световой сигнал обнаружения признаков пожара необходимо выполнить таким образом, чтобы он состоял из двух указателей (двух ламп или двойной нити накаливания), или должно быть предусмотрено специальное устройство для контроля исправности ламп сигнализации. Цвет светового сигнала должен соответствовать требованиям 4.6.5.
Световые сигналы должны быть раздельными для каждого рода информации.
Сигналы, служащие для определения расположения помещения или района, из которого поступил импульс, могут быть общими с сигналом обнаружения признаков пожара или повреждения.
Световые сигналы должны действовать с момента получения импульса до момента устранения причины их срабатывания, причем сигнал, указанный в п. 1 табл. 7.4.6, должен действовать постоянно независимо от рода питания.

Таблица 7.4.6

№ п/п	Сигнализация о режимах работы и неисправностях	Сигнал при применении систем температурной сигнализации обнаружения пожара	Сигнал при применении систем, в которых воздух поступает из охраняемых помещений в приемное устройство сигнализации
1	Работа устройства	Световой	Световой
2	Питание от аварийного источника	Световой	Световой
3	Признаки пожара и местонахождение помещения или района, в котором обнаружены признаки пожара	Звуковой Световой	Звуковой Световой
4	Отсутствие тяги в обнаружительной камере	–	Световой Звуковой
5	Отсутствие тяги в трубопроводах	–	Световой Звуковой[1]
6	Обрыв в цепях датчиков	Световой Звуковой	–
7	Местонахождение повреждений цепи датчиков	Световой	–
8	Отключенное состояние извещательной линии[1]	Световой	–
9	Исчезновение питания	Световой Звуковой	Световой Звуковой

[1] Рекомендуется.

7.4.7 Сигнализация обнаружения пожара должна отвечать следующим требованиям:
.1 срабатывание любого автоматического или ручного извещателя должно вызывать подачу светового и звукового сигналов о пожаре на панели управления станцией и на панелях сигнализации. Если в течение 2 мин эти сигналы не привлекут внимания, то во всех жилых помещениях экипажа и служебных помещениях, в постах управления, а также в машинных помещениях категории А автоматически должен подаваться звуковой сигнал тревоги. Нет необходимости в том, чтобы система подачи такого звукового сигнала тревоги являлась составной частью системы обнаружения пожара;
.2 панель управления станцией должна располагаться на ходовом мостике или в центральном посту управления с постоянной вахтой. Одна из панелей сигнализации должна находиться на ходовом мостике, если панель управления станцией находится в центральном пожарном посту;
.3 панели сигнализации должны, как минимум, указывать луч, в котором сработал автоматический или ручной извещатель;
.4 на каждой панели сигнализации или вблизи нее должна быть четкая информация об обслуживаемых помещениях и о расположении лучей.

7.4.8 Системы обнаружения пожара, способные дистанционно определять расположение помещения, из которого поступил сигнал обнаружения пожара, должны быть выполнены так, чтобы:
.1 петля не проходила через помещения более одного раза для исключения ее повреждения при пожаре более чем в одной точке. В случае необходимости такой прокладки в помещениях с большой площадью, части петли, проходящие через эти помещения дважды, должны быть разнесены на возможно большее расстояние друг от друга;
.2 были предусмотрены средства, которые при любом повреждении в петле (например, обрыв, короткое замыкание, заземление) сохраняли бы ее работоспособность. Это означает, что в случае повреждения в петле только часть петли остается неработоспособной по аналогии выхода из строя не более одной секции в системе сигнализации обнаружения пожара без дистанционного определения положения каждого извещателя;
.3 была предусмотрена возможность быстрого восстановления работоспособности системы в случае выхода из строя ее электрических, электронных элементов, а также при искажении информации;

.4 срабатывание первого сигнала пожарной сигнализации не препятствовало бы срабатыванию любого другого извещателя и подаче последующих сигналов тревоги.

7.4.9 Извещатели системы сигнализации обнаружения пожара, содержащие источники ионизирующего излучения (радиоактивные изотопы), должны иметь свидетельство, подтверждающее их радиационную безопасность, выданное компетентной организацией.

7.4.10 Извещатели должны отвечать следующим требованиям:
.1 автоматические извещатели должны срабатывать под воздействием тепла, дыма или других продуктов горения, пламени или любого сочетания этих факторов. Регистр может рассмотреть возможность применения автоматических извещателей, срабатывающих под воздействием других факторов, указывающих на возникновение пожара, при условии, что они являются не менее чувствительными, чем указанные выше извещатели. Световые извещатели должны применяться лишь как дополнение к тепловым или дымовым извещателям;
.2 дымовые извещатели должны срабатывать до того, как плотность дыма достигнет величины, при которой ослабление света превысит 12,5 % на 1 м, но не раньше, чем плотность дыма достигнет величины, при которой ослабление света превысит 2 % на 1 м. Дымовые извещатели, устанавливаемые в машинных помещениях категории A, камбузе и котельных отделениях, должны срабатывать при такой плотности дыма, при которой ослабление света достигнет не более 50 % на 1 м;
.3 тепловые извещатели, устанавливаемые в помещениях с нормальной температурой воздуха, должны срабатывать в интервале температур 54 ─ 78 °C при повышении температуры до этих пределов со скоростью менее 1 °C/мин. Регистр может рассмотреть возможность применения тепловых извещателей с большей скоростью повышения температуры, принимая во внимание их чувствительность;
.4 температура срабатывания тепловых извещателей в сушильных и подобных им помещениях, для которых обычно характерна высокая температура воздуха, может быть повышена до 30 °C сверх максимальной температуры в верхней части этих помещений;
.5 тепловые извещатели должны надежно работать при температуре, по крайней мере, на 5 °C выше температуры настройки чувствительного элемента;
.6 в машинных помещениях категории A могут также применяться извещатели, обнаруживающие очаг пожара по появлению пульсации температуры (теплоимпульсные). Извещатели должны быть настроены на частоту пульсаций температуры от 1,9 ─ 2,3 Гц и выше и срабатывать при превышении амплитуды на (2±0,5) °C независимо от температуры помещения;
.7 все автоматические извещатели должны быть такого типа, чтобы они могли испытываться на правильное срабатывание и возвращаться в режим нормальной работы без замены каких-либо элементов.

7.4.11 Лучи извещателей и их кабели должны отвечать следующим требованиям:
.1 автоматические и ручные извещатели должны быть сгруппированы в лучи (секции);
.2 луч автоматических пожарных извещателей, обслуживающий пост управления, жилое или служебное помещение, не должен обслуживать машинное помещение категории A, камбуз и котельные отделения. Если система сигнализации обнаружения пожара позволяет дистанционно определять конкретное место возникновения пожара, петля, охватывающая лучи автоматических пожарных извещателей в жилых и служебных помещениях и в постах управления, не должна обслуживать машинное помещение категории A, камбуз и котельные отделения;
.3 не допускается обслуживание каким-либо лучом более одной палубы в пределах жилых и служебных помещений и постов управления, за исключением луча, обслуживающего выгородку трапа, если стационарная система сигнализации обнаружения пожара не включает в себя средств дистанционного определения конкретного места возникновения пожара каждым отдельным автоматическим извещателем. Количество выгороженных помещений, обслуживаемых одним лучом, не должно превышать 50. Если система позволяет

дистанционно определять место возникновения пожара каждым отдельным автоматическим извещателем, лучи могут обслуживать несколько палуб и любое количество помещений;
.4 не допускается установка на одном луче более 100 извещателей;
.5 кабели лучей, включая кабели их питания, составляющих часть системы, должны быть проложены в обход камбузов, машинных помещений категории А и других выгороженных помещений с высокой пожарной опасностью, за исключением случаев, когда необходимо обеспечить обнаружение пожара или сигнализацию о пожаре в таких помещениях (см. 16.8.1.8).».

Вводятся новые главы **7.6** и **7.7** следующего содержания:

«7.6 СИГНАЛИЗАЦИЯ КОНТРОЛЯ СОСТОЯНИЯ ПАССАЖИРОВ С ОГРАНИЧЕННЫМИ ВОЗМОЖНОСТЯМИ

7.6.1 В помещениях судна, в которых возможно пребывание пассажиров с ограниченными возможностями к передвижению и где их состояние не может визуально контролироваться членами экипажа, персоналом судна или другими пассажирами, должны быть установлены кнопки вызывной сигнализации, при нажатии которой визуальный и звуковой сигналы тревоги могут быть переданы на приёмное устройство, установленное в помещении с постоянной вахтой.

7.6.2 Сигнализация контроля состояния пассажиров с ограниченными возможностями должна получать питание от основного и аварийного источников электрической энергии.
Допускается подключать систему сигнализации непосредственно к аварийному распределительному щиту при условии, что в нормальных условиях АРЩ получает питание от основного источника электрической энергии.

7.7 СИГНАЛИЗАЦИЯ О НАЛИЧИИ ГАЗА В ПОМЕЩЕНИИ

7.7.1 На пассажирских судах, использующих сжиженный газ в хозяйственных целях, должна быть предусмотрена система сигнализации о превышении допустимой концентрации газа в помещении.

7.7.2 Сигнализация должна срабатывать при достижении концентрации газа 10 % от нижнего предела взрываемости (НПВ) смеси пропана и воздуха или 30 частей на миллион угарного газа (окиси углерода). При этом время срабатывания сигнализации не должно превышать 20 с.

7.7.3 Система сигнализации должна быть сконструирована таким образом, чтобы был обеспечен контроль состояния цепей соединения. Должна быть предусмотрена сигнализация о неисправностях системы газоанализа с указанием возможных причин их вызвавших.

7.7.4 Система сигнализации должна сохранять работоспособность при температуре окружающего воздуха от -10 до +40 °С и влажности от 20 до 100 %.

7.7.5 Звуковой и визуальный сигналы о достижении или превышении концентраций, указанных в 7.7.2, должны подаваться как в контролируемое помещение, так и в рулевую рубку или другое помещение судна с постоянной вахтой.
Звуковой и визуальный сигналы должны быть отличимы от других сигналов, подаваемых в данные помещения, и ясно различимы при самых высоких уровнях шума в данных помещениях.
Звуковой сигнал должен быть слышен при закрытых входных дверях или дверях, соединяющих соседние помещения.
Отключение звукового сигнала возможно только после его квитирования, а визуального сигнала - только после устранения причин его вызвавших.
Кнопка квитирования должна иметь самовозврат.
Аналогичные сигналы должны подаваться при отказе системы или одного из её компонентов.
При этом отключение сигналов должно быть таким же, как и при срабатывании системы.

7.7.6 Должны быть предусмотрены меры по предотвращению несанкционированного отключения системы или её компонентов, а также защита от несанкционированного вмешательства в её функционирование.

7.7.7 Устройства управления системой не должны размещаться в контролируемых помещениях.

7.7.8 Датчики системы сигнализации должны размещаться в контролируемых помещениях вблизи оборудования, потребляющего газ, таким образом, чтобы скопление газа обнаруживалось до достижения предельных значений, упомянутых в 7.7.1.
Выбор места установки должен быть обоснован производителем или специальной компанией по установке оборудования. Трубки оборудования по отбору проб должны быть как можно короче.

7.7.9 К датчикам должен быть обеспечен легкий доступ, чтобы возможно было осуществлять регулярную калибровку, эксплуатацию и контроль безопасности.

7.7.10 В системе сигнализации должно быть предусмотрено не менее двух источников электрической энергии, один из которых должен быть аварийным.
При исчезновении питания от основного источника электрической энергии должно быть предусмотрено автоматическое переключение на аварийный источник.».

19.1 ПАССАЖИРСКИЕ СУДА

19.1.3.1.2 После слов «ОППД» дополняется текстом «, систем низкорасположенного освещения с электрическим питанием;».

19.1.3.4.1 Слова «и сигнально-отличительных фонарей» заменяются словами«, сигнально-отличительных фонарей и систем низкорасположенного освещения с электрическим питанием», и далее по тексту.

ЧАСТЬ X. АВТОМАТИЗАЦИЯ

2.6 АВТОМАТИЗИРОВАННЫЕ КОМПРЕССОРНЫЕ УСТАНОВКИ

2.6.1 заменяется следующим текстом:
«**2.6.1** Пополнение воздухохранителей воздуха для работы тифона, воздуха для питания систем автоматизации, а для судов с реверсивными главными двигателями внутреннего сгорания также и воздухохранителей пускового воздуха должно быть автоматическим.
Для автоматизированных компрессоров необходимо предусматривать также возможность их пуска и остановки из рулевой рубки или ЦПУ.
Вместо автоматического пополнения воздухохранителей пускового воздуха судов с реверсивными главными двигателями внутреннего сгорания допускается предусматривать дистанционный пуск компрессора с дизельным приводом из рулевой рубки. В последнем случае в рулевой рубке должна быть обеспечена АПС о низком уровне топлива в расходной цистерне указанного привода.».

2.7 АВТОМАТИЗИРОВАННЫЕ НАСОСНЫЕ УСТАНОВКИ

Вводится новый пункт **2.7.4** следующего содержания:
«**2.7.4** Должно быть предусмотрено автоматическое пополнение расходной цистерны главных механизмов (при ее наличии). При этом топливоподкачивающий насос либо должен работать постоянно, либо следует предусматривать датчики нижнего и верхнего уровня топлива, соответственно включающие и отключающие насос. Расходная цистерна должна оборудоваться АПС, подающей сигнал при снижении уровня топлива ниже предельно допустимого (см. 2.11.9).».

Номер существующего пункта **2.7.3** заменяется на **2.7.2**, а номер существующего пункта **2.7.2** – на **2.7.3**.

2.11 СИСТЕМА ЗАЩИТЫ ИНДИКАЦИИ И РЕГУЛИРОВАНИЯ

Таблица 2.11.9

Пункт **6.2** в колонке «Пояснения» дополняется следующим текстом:
«Для расходной цистерны дизельных приводов компрессоров пускового воздуха сигнализация выводится в рулевую рубку».

ЧАСТЬ XIII. СРЕДСТВА ПО ПРЕДОТВРАЩЕНИЮ ЗАГРЯЗНЕНИЯ С СУДОВ

2.1 ОПРЕДЕЛЕНИЯ И ПОЯСНЕНИЯ

2.1.1 Определение «Нефтеналивное судно» заменяется следующим текстом:
«Нефтеналивное судно - судно, построенное или приспособленное главным образом для перевозки нефти наливом в грузовых помещениях, включает комбинированное судно, любое наливное судно типа **N** и **C**, предназначенное для перевозки вредных жидких веществ наливом, и любое наливное судно типа **G,** если они перевозят в качестве груза или части груза нефть наливом, определение которым дано в 1.1.2 части I «Классификация».

2.2 ОБЩИЕ ТРЕБОВАНИЯ

2.2.1.6 дополняется текстом «…, отвечающими требованиям Администрации.».
Вводится новый абзац следующего содержания:
«Конструкция донно-бортовой арматуры должна предусматривать возможность пломбирования в случаях, когда сброс запрещен.».

Вводится новый пункт **2.2.1.7** следующего содержания:
«**.7** требования 2.9 - 2.11 распространяются на суда под флагом РФ.».

2.3 ТРЕБОВАНИЯ К НЕФТЕНАЛИВНЫМ СУДАМ

2.3.2.5.1 «0,6 м» заменяется на «0,6 м для судов типа **C** и 0,5 м для судов типа **N**;».

2.3.2.5.4 «0,5 м» заменяется на «0,5 м для судов типа **C** и 0,4 м для судов типа **N**;».

2.7 СИСТЕМЫ ПЕРЕКАЧКИ, СДАЧИ И СБРОСА НЕФТЕСОДЕРЖАЩИХ СМЕСЕЙ

2.7.2.1 В первом предложении после слов «соединения которого» дополняется текстом «…отвечают требованиям Администрации бассейна и», и далее по тексту

2.12 ЗАЩИТА ТОПЛИВНЫХ ТАНКОВ СУДОВ

2.12.2.1 и **2.12.2.2** «0,6 м» заменяется на «0,5 м».

2.12.2.4 и **2.12.2.6** «0,5 м» заменяется на «0,4 м».

3.2 ОБЩИЕ ТРЕБОВАНИЯ

3.2.1.2 дополняется текстом «…, отвечающие требованиям Администрации.».

3.5 УСТАНОВКИ ДЛЯ ОБРАБОТКИ СТОЧНЫХ ВОД

3.5.2 дополняется текстом «…, для судов под флагом РФ.».

4.3 ОБОРУДОВАНИЕ И УСТРОЙСТВА ДЛЯ СБОРА, ХРАНЕНИЯ И ПЕРЕРАБОТКИ МУСОРА

4.3.1.1 дополняется текстом «…, отвечающими требованиям Администрации.».

4.3.4.1 после слов «на судне» дополняется текстом «под флагом РФ», и далее по тексту.

5.1 ОБЩИЕ ПОЛОЖЕНИЯ

Вводится новый пункт **5.1.2** следующего содержания:

«**5.1.2** Вредные жидкие вещества – любые вещества категории X, У или Z, указанные в колонке категории загрязнителя гл. 17 или 18 Международного кодекса по химовозам (МКХ).».

6.2 ОПРЕДЕЛЕНИЯ И ПОЯСНЕНИЯ

6.2.1 В определении «Система сбора паров груза» слова «нефтеналивного судна» заменяются словами «нефтеналивного судна или химовоза».

6.6 ЛЕТУЧИЕ ОРГАНИЧЕСКИЕ СОЕДИНЕНИЯ

6.6.1 Слово «нефтеналивные» заменяется словом «наливные».

ЧАСТЬ XIV. ТРЕБОВАНИЯ К СУДАМ, ПЕРЕВОЗЯЩИМ ОПАСНЫЕ ГРУЗЫ

1.2 ОПРЕДЕЛЕНИЯ И ПОЯСНЕНИЯ

1.2.1 Определение «Защищенная зона» дополняется следующим текстом:
«Классификация зон (см. Директиву 1999/92/ЕС):
Зона 0 – места, где постоянно или в течение длительных периодов времени существует взрывоопасное скопление газов, паров или взвесей;
Зона 1 – места, где при нормальном функционировании может образовываться взрывоопасное скопление газов, паров или взвесей;
Зона 2 – места, где при нормальном функционировании едва ли может образовываться взрывоопасное скопление газов, паров или взвесей, или где такая взрывоопасная атмосфера сохраняется, в случае её образования, лишь в течение короткого периода времени.».

2.3 ТРЕБОВАНИЯ К НАЛИВНЫМ СУДАМ ТИПА G

2.3.10 заменяется следующим текстом:

«**2.3.10** Конструкция корпуса должна отвечать требованиям 3.1 части II «Корпус». При иной конструкции корпуса (не оговоренной в 3.1 части II «Корпус») в пределах грузового пространства посредством расчетов должно быть доказано, что в случае бокового столкновения с другим судном, имеющим нос с прямым форштевнем, может быть поглощена энергия в 22 МДж без разрыва грузовых танков и трубопроводов, соединенных с грузовыми танками.».

2.3.11 заменяется следующим текстом:

«**2.3.11** Грузовые танки и конструкция корпуса в пределах грузового пространства должны быть спроектированы в соответствии с требованиями 3.1.2 части II «Корпус». Охлаждаемые грузовые танки могут быть установлены только в трюмных помещениях, ограниченных междубортовым и междудонным пространством. Конструкция крепежных приспособлений грузовых танков является предметом специального рассмотрения Регистром.».

2.4 ТРЕБОВАНИЯ К НАЛИВНЫМ СУДАМ ТИПА С

2.4.1 Исключаются ссылки на требования 2.3.10 и 2.3.11.

2.4.2 заменяется следующим текстом:

«**2.4.2** Конструкция корпуса должна отвечать требованиям 3.1 части II «Корпус».».

2.4.3 заменяется следующим текстом:

«**2.4.3** Грузовые танки и конструкция корпуса в пределах грузового пространства должны быть спроектированы в соответствии с требованиями 3.1.2 части II «Корпус». Грузовые танки, не являющиеся частью корпуса судна, и охлаждаемые грузовые танки могут быть установлены только в трюмных помещениях, ограниченных междубортовым и междудонным пространством. Грузовые танки не должны выходить за границы палубы.».