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Rules for the Classification of Floating Establishments

PART A - Classification and Surveys
PART B - Hull and Stability
PART C - Machinery, Systems and Electricity
PART D - Additional Requirements for Notations

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MARINE DIVISION
GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine Division (the "Society") is the classification (" Classification ") of any ship or vessel or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- prepares and publishes Rules for classification, Guidance Notes and other documents ("Rules");
- issues Certificates, Attestations and Reports following its interventions ("Certificates");
- publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as " Certification ".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as " Services ". The party and/or its representative requesting the services is hereinafter referred to as the " Client ". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisement given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisement is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisement or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

ARTICLE 3

3.1. - **The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.**

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- conducts surveys at the place of their construction;
- classes Units and enters their class in its Register;
- surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.

5.2. - The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder, respectively.

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - If the Services of the Society cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee.

The Society bears no liability for indirect or consequential loss such as e.g. loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on of were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. Overdue amounts are increased as of right by interest in accordance with the applicable legislation.

8.3. - The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the **classification file** consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit;
- copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, are passed on to IACS (International Association of Classification Societies) according to the association working rules;
- the certificates, documents and information relative to the Units classed with the Society may be reviewed during certificating bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France.

12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

ARTICLE 13

13.1. - **These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement.**

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.

RULE NOTE NR 580

NR 580

Rules for the Classification of Floating Establishments

Part A	**Classification and Surveys**
Part B	**Hull and Stability**
Part C	**Machinery, Systems and Electricity**
Part D	**Additional Requirements for Notations**

September 2012

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Chapters **1 2 3**

September 2012

Part A
Classification and Surveys

Chapter 1
PRINCIPLES OF CLASSIFICATION

SECTION 1 GENERAL PRINCIPLES OF CLASSIFICATION

1 Principles of classification

1.1 Purpose of the Rules

1.1.1 The requirements of this Rule Note apply specifically to floating units, moored or anchored in smooth stretches of water, for the assignment and maintenance of the type and service notation **Floating establishment** as defined in Ch 1, Sec 2, [1.6.1].

A special consideration will be given to units intended to be operated on stretches of water where different conditions of water surface may be encountered.

1.1.2 The Class assigned to a unit reflects the discretionary opinion of the Society that the unit, for declared conditions of use and within the relevant time frame, complies with the Rules applicable at the time the service is rendered.

1.1.3 The General Conditions valid at the time of signing of the contract with the Owner or Prospective Owner, the Building Yard or Other Interested party apply.

1.1.4 Classification according to this Rule Note applies primarily to new buildings constructed under survey of the Society. Classification may also be applied to existing units by a survey for admission to class/classification after construction, if sufficient documentation is available, see Ch 2, Sec 4, [1.2].

1.1.5 This Rule Note will be applied for structural elements of the hull and for components of the machinery and electrical installations of floating units, subject to agreement between the Prospective Owner, the Other Interested party and the Building Yard for the classification order to the Society.

1.1.6 A Floating establishment not covered by any of the types defined in [1.2.18] will be classed on the basis of the requirements applicable to the type of unit having the most similar intended mission.

1.1.7 The division into types of floating establishments according to [1.2.18] does not preclude the existence on the same unit of several activities corresponding to various types or similar types each of which, taken alone, would not meet the requirements of this Rule Note. However, this group of activities will be permitted only if they comply together and individually with the requirements prescribed by this Rule Note.

1.2 General definitions

1.2.1 Administration / Authorities

Administration/Authorities means the Government of the registry state.

1.2.2 Building specification

The building specification is part of the building contract between the Prospective Owner, Other Interested Party and the Building Yard which specifies the technical parameters and all other details for the construction of the unit.

1.2.3 Building Yard

The Building Yard is the contractual partner of the Prospective Owner or Other Interested Party, entrusted with managing the design, construction and equipment of the unit, generally together with a series of subcontractors and manufacturers.

1.2.4 Categories of units

Floating units are subdivided into categories depending on the number of persons admitted (public and staff), according to Tab 1.

Table 1 : Category definition

Category	Number of persons, n
1	$n > 1500$
2	$701 \le n \le 1500$
3	$301 \le n < 701$
4	$n_0 < n \le 300$
5	$12 < n \le n_0$
n_0	: Minimum number of persons, defined in the relevant Section of Part D, Chapter 1, for the unit type considered.

1.2.5 Essential service

Essential service is intended to mean a service necessary for a unit to undertake activities connected with its operation, and for the safety of life, as far as class is concerned.

1.2.6 Hull

The hull is the structural body of a unit including all strength components, i.e. shell plating, walls, framing, decks, bulkheads, etc. of the main hull, superstructures and deckhouses. The hull also includes:

- all portions of the unit extending beyond the main hull outline (appendages)
- river chests
- structures permanently connected by weld to the unit's hull such as guard rails, bitts, fixed parts of lifting appliances, machinery bedding, etc.
- tanks integrated to the hull structure.

1.2.7 Other Interested Party

Other Interested Party means other ordering subcontractors such as the Broker, the Designer, the Engine and components Manufacturer, or the Supplier of parts to be tested, etc.

1.2.8 Owner or Prospective Owner

Owner or Prospective Owner means the Registered Owner or the Disponent Owner or the Manager or any other party responsible for the definition, purchase and/or operation of the unit and having the responsibility to keep the unit in good condition, having particular regard to the provisions relating to the maintenance of class laid.

1.2.9 Period of class

Period of class means the period starting either from the date of the initial classification or from the credited date of the last class renewal survey, and expiring at the limit date assigned for the next class renewal survey.

1.2.10 Public

Public includes all persons admitted on board a floating establishment, in addition to the unit staff.

1.2.11 Smooth stretches of water

Smooth stretches of water cover operation of units on water stretches where the maximum wave height does not exceed 0,6 m.

1.2.12 Society

Society means the Classification Society with which the unit is classed.

1.2.13 Statutory Rules

Statutory Rules are the national and international Rules and Regulations which apply to the unit but which are not covered by the classification.

1.2.14 Survey

Survey means an intervention by the Surveyor for assignment or maintenance of class, or interventions by the Surveyor within the limits of the tasks delegated by the Administrations.

1.2.15 Surveyor

Surveyor means technical staff acting on behalf of the Society to perform tasks in relation to classification and survey duties.

1.2.16 Type approval

Type approval means an approval process for verifying compliance with the Rules of a product, a group of products or a system, and considered by the Society as representative of continuous production.

1.2.17 Unit

Unit means any floating establishment as defined in Ch 1, Sec 2, [1.6.1].

1.2.18 Type of floating establishments

Floating establishments are classified, according to their mission, into types defined in Ch 1, Sec 2, [1.7.2].

1.3 Date of "contract for construction"

1.3.1 The date of "contract for construction" of a unit is the date on which the contract to build the unit is signed between the Prospective Owner or the Other Interested Party and the Building Yard. This date is normally to be declared to the Society by the ordering client applying for the assignment of class to a new building.

The date of "contract for construction" of a series of units, including specified optional units for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the Prospective Owner or Other Interested Party and the Building Yard.

For the purpose of this definition, units built under a single "contract for construction" are considered a "series of units" if they are built to the same reviewed / approved plans for classification purposes. However, units within a series may have design alterations from the original design provided:

- such alterations do not affect matters related to classification, or
- if the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the Prospective Owner or Other Interested Party and the Building Yard or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for review/approval.

The optional units will be considered part of the same series of units if the option is exercised not later than 1 year after the contract to build the series was signed.

If a "contract for construction" is later amended to include additional units or additional options, the date of "contract for construction" for such units is the date on which the amendment to the contract is signed between the Prospective Owner or Other Interested Party and the Building Yard. The amendment to the contract is to be considered as a "new contract" to which the above applies.

If a "contract for construction" is amended to change the unit type, the date of "contract for construction" of this modified unit or units, is the date on which the revised contract or new contract is signed between the Prospective Owner, or Prospective Owners, and the Building Yard.

1.4 Meaning of classification, scope and limits

1.4.1 The Rules, surveys performed, reports, certificates and other documents issued by the Society, are in no way intended to replace or alleviate the duties and responsibilities of other parties, such as Administrations, Designers, Building Yard, Manufacturers, Repairers, Suppliers, Contractors or Subcontractors, actual or Prospective Owners or Operators and Underwriters. The Society cannot therefore assume the obligations arising from these functions, even when the Society is consulted to answer inquiries concerning matters not covered by its Rules, or other documents.

1.4.2 The activities of such parties which fall outside the scope of the classification as set out in the Rules, such as design, engineering, manufacturing, operating alternatives, choice of type and power of machinery and equipment, number and qualification of operating personnel, remain therefore the responsibility of those parties, even if these matters may be given consideration for classification according to the type of the unit or additional class notation assigned.

1.4.3 The classification-related services and documents performed and issued by the Society do not relieve the parties concerned of their responsibilities or other contractual obligations expressed or implied or of any liability whatsoever, nor do they create any right or claim in relation to the Society with regard to such responsibilities, obligations and liabilities. In particular, the Society does not declare the acceptance or commissioning of a unit or any part of it, this being the exclusive responsibility of the Owner or Other Interested Party.

1.4.4 Unless otherwise specified, the Rules do not deal with structures, pressure vessels, machinery and equipment which are not permanently installed and used solely for operational activities, except for their effect on the classification-related matters, such as the unit's general strength.

1.4.5 During periods of construction, modification or repair, the unit is solely under the responsibility of the Builder or the Repair Yard. As an example, the Builder or Repair Yard is to ensure that the construction, modification or repair activities are compatible with the design strength of the unit and that no permanent deformations are sustained.

1.4.6 Structures, machinery and equipment determining the type of unit are subject to examination within the scope of classification, in accordance with the character of classification and affixed class notations.

Other systems and components may be included in the classification and/or certification procedure upon request of the Prospective Owner, the Other Interested Party and the Building Yard.

1.4.7 It is assumed that all parties involved in the planning and design, materials and components production and installation have the professional qualifications required and/or suitable facilities/equipment for fabrication. This will normally be established or confirmed by means of a certified quality assurance management system in accordance with ISO 9000, or equivalent.

1.4.8 When it is agreed to limit the classification to the unit's hull only, the parts of the unit which are to comply with the Rules are those mentioned in [1.2.6]. In such a case, the applicable stability requirements are also to be complied with and the classification notations defined in Ch 1, Sec 2, [1] will be assigned only to the hull. Machinery, systems and electrical installations which are normally matters for classification are to be in compliance with the requirements of the competent Authority.

1.5 Request for services

1.5.1 Requests for interventions by the Society, such as request for classification, surveys during construction, surveys of units in service, tests, etc., are in principle to be submitted in writing and signed by the Other Interested Party, the Owner, the Prospective Owner or the Building Yard. Such request implies that the applicant will abide by all the relevant requirements of the Rules and the General Conditions of the Society.

2 Rules

2.1 Effective date

2.1.1 The effective date of entry into force of any amendments to the Rules is indicated on the inside front page of the Rules or in the relevant Section.

2.2 Application

2.2.1 In principle, the applicable Rules for assignment of class to a new unit are those in force at the date of contract for construction. In the case of admission to class after construction, the Rules in force at the date of the request for classification apply.

2.2.2 Special consideration may be given to applying new or modified rule requirements which entered into force subsequent to the date of the contract for construction, at the discretion of the Society and in the following cases:

- when a justified written request is received from the party applying for classification
- when the keel is not yet laid and more than one year has elapsed since the contract was signed
- where it is intended to use existing previously approved plans for a new contract.

2.2.3 The above procedures for application of the Rules are, in principle, also applicable to existing units in the case of major conversions and, in the case of alterations, to the altered parts of the unit.

2.2.4 The rule requirements related to assignment, maintenance and withdrawal of the class of units already in operation are applicable from the date of their entry into force.

2.3 Equivalence

2.3.1 The Society may consider the acceptance of alternatives to this Rule Note, provided that they are deemed to be equivalent, to the satisfaction to the Society.

2.3.2 As a rule, materials and equipment type approved in compliance with NR467 Rules for Steel Ships are considered acceptable within the scope of this Rule Note for the classification of floating establishments.

2.4 Novel features

2.4.1 The Society may consider the classification of units based on or applying novel design principles or features, to which the Rule Note is not directly applicable, on the basis of experiments, calculations or other supporting information provided to the Society. The specific limitations will then be indicated on a memoranda.

2.5 Other construction Rules and Regulations

2.5.1 The appraisal of design and construction particulars by the Society will be exclusively based on Rules and Guidelines agreed upon in the specification of the classification contract between the Prospective Owner, the Other Interested Party or the Building Yard and the Society.

2.5.2 In addition, statutory construction Rules for floating establishments, may be applied upon agreement with the relevant Authority and if defined in the specification of the classification contract between the Prospective Owner, the Other Interested Party or the Building Yard and the Society.

2.5.3 The compliance to statutory Rules of the respective registry country is the responsibility of the Prospective Owner.

2.6 Industry Codes, Standards, etc.

2.6.1 Internationally recognized Standards and Codes published by relevant organisations, national industry organisations or standardisation institutions may be used upon agreement in particular cases as a design and construction basis.

Examples: ISO, IEC, EN, DIN, NF.

2.7 Application of statutory Rules by the Society

2.7.1 When authorised by the Administration concerned, the Society will act on its behalf within the limits of such authorisation. In this respect, the Society will take into account the relevant requirements, survey the unit, report and issue or contribute to the issue of the corresponding certificates.

2.7.2 The above surveys do not fall within the scope of the classification of units, even though their scope may overlap in part and may be carried out concurrently with surveys for assignment or maintenance of class.

In the case of a discrepancy between the provisions of the applicable international and national Regulations and those of the Rules, normally, the former take precedence. However, the Society reserves the right to call for the necessary adaptation to preserve the intention of the Rules.

3 Duties of the Interested Parties

3.1 International and National Regulations

3.1.1 The classification of a unit does not dispense the Owner, Other Interested Party and Building Yard from compliance with any requirements issued by Administrations.

3.2 Surveyor's intervention

3.2.1 Surveyors are to be given free access at all times to units which are classed or being classed, Building Yard and manufacturer works, to carry out their interventions within the scope of assignment or maintenance of class, or within the scope of interventions carried out on behalf of Administrations, when so delegated.

Free access is also to be given to experts or/and auditors accompanying the Surveyors of the Society within the scope of the audits as required in pursuance of the Society's internal Quality System or as required by external organizations.

3.2.2 Owners, Other Interested Parties and Building Yard are to take the necessary measures for the Surveyor's inspections and testing to be carried out safely and efficiently under their full responsibility. Owners, Other Interested Parties and Building Yard - irrespective of the nature of the service provided by the Surveyors of the Society or others acting on its behalf - assume with respect to such Surveyors all the responsibility of an employer for his workforce such as to meet the provisions of applicable legislation. As a rule, the Surveyor is to be constantly accompanied during surveys by personnel of the Owner, Other Interested Party or Building Yards.

3.2.3 The certificate of classification and/or other documents issued by the Society remain the property of the Society. All certificates and documents necessary to the Surveyor's interventions are to be made available by the Owner, Other Interested Party or Building Yard to the Surveyor on request.

3.2.4 During the phases of design and construction of the unit, due consideration should be given to Rule requirements in respect of all necessary arrangements for access to spaces and structures with a view to carrying out class surveys. Arrangements of a special nature are to be brought to the attention of the Society.

3.3 Operation and maintenance of units

3.3.1 The classification of a unit is based on the understanding that the unit is operated in a proper manner by competent and qualified operating personnel according to the environmental, loading, operating and other criteria on which classification is based.

3.3.2 In particular, it will be assumed that the draught of the unit in operating conditions according to normal prudent conduct will not exceed that corresponding to the freeboard assigned or the maximum approved for the classification, that the unit will be properly loaded taking into account both its stability and the stresses imposed on its structures.

3.3.3 Any document issued by the Society in relation to its interventions reflects the condition of the unit as found at the time and within the scope of the survey. It is the Interested Party's responsibility to ensure proper maintenance of the unit until the next survey required by the Rules. It is the duty of the Interested Party to inform the Surveyor when he boards the unit of any events or circumstances affecting the class.

3.4 Use of measuring equipment and of service suppliers

3.4.1 General

Firms providing services on behalf of the Interested Party, such as measurements, tests and servicing of safety systems and equipment, the results of which may form the basis for the Surveyor's decisions, are subject to the acceptance of the Society, as deemed necessary.

The equipment used during tests and inspections in workshops, shipyards and on board units, the results of which may form the basis for the Surveyor's decisions, is to be customary for the checks to be performed. Firms are to individually identify and calibrate to a recognised national or international standard each piece of such equipment.

3.4.2 Simple measuring equipment

The Surveyor may accept simple measuring equipment (e.g. rulers, tape measures, weld gauges, micrometers) without individual identification or confirmation of calibration, provided it is of standard commercial design, properly maintained and periodically compared with other similar equipment or test pieces.

3.4.3 On board measuring equipment

The Surveyor may accept measuring equipment fitted on board a unit (e.g. pressure, temperature or rpm gauges and meters) and used in examination of on board machinery and/or equipment based either on calibration records or comparison of readings with multiple instruments.

3.4.4 Other equipment

The Surveyor may request evidence that other equipment (e.g. tensile test machines, ultrasonic thickness measurement equipment, etc.) is calibrated to a recognised national or international standard.

3.5 Spare parts

3.5.1 It is the Owner's responsibility to decide whether and which spare parts are to be stored on board.

3.5.2 As spare parts are outside the scope of classification, the Surveyor will not check that they are kept on board, maintained in a satisfactory condition, or suitably protected and lashed.

However, in the case of repairs or replacement, the spare parts used are to meet the requirements of the Rules as far as practicable.

SECTION 2 CLASS DESIGNATION

1 General

1.1 Purpose of the classification notations

1.1.1 The class of a floating unit complying with this Rule Note is expressed by its classification notations assigned for hull and machinery, including electrical installations.

1.1.2 There are different kinds of classification notations, describing particular features, capabilities, service restrictions or special equipment and installations included in the classification.

1.1.3 The classification notations give the scope according to which the class of the unit has been based and refer to the specific rule requirements which are to be complied with for their assignment. In particular, the classification notations are assigned according to the additional service features of the unit and other criteria which have been provided by the Owner, Building Yard or Other Interested Party, when applying for classification.

1.1.4 The Society may change the classification notations at any time, when the information available shows that the requested or already assigned notations are not suitable for the intended mission and any other criteria taken into account for classification.

Note 1: Reference is to be made to Ch 1, Sec 1, [1.4] on the limits of classification and its meaning.

1.1.5 The classification notations assigned to a unit are indicated on the certificate of classification, as well as in the Register published by the Society.

It will be the decision of the Owner, Building Yard or Other Interested Party to have the notations, together with the whole class designation, included in the Register published by the Society or not.

1.1.6 The classification notations applicable to existing units conform to the Rules of the Society in force at the date of assignment of class. However, the classification notations of existing units may be updated according to the current Rules, as far as applicable.

1.1.7 At the request of the Owner and as far as applicable, the Society reserves the right to grant other class notations as defined in other Rules of the Society. The class maintenance surveys for such classification notations are to be performed to the corresponding requirements in the other Rules of the Society.

1.2 Types of notations assigned

1.2.1 The types of classification notations assigned to a unit are the following:

a) character of construction

b) quarter term and intermediate surveys

In the case of quarter term and intermediate surveys, as a rule, no postponement is granted. The surveys are to be completed within their prescribed windows.

c) character of class period

d) "Floating establishment" completed with additional service features

e) additional class notations (optional).

The different classification notations and their conditions of assignment are defined in [1.3] to [1.8].

1.2.2 Examples of class designation

Tab 1 shows examples of a class designation for hull and machinery of a unit covered by this Rule Note.

Table 1 : Examples of class designation

Unit type	Class designation
Hotel	✠ **II 5** **Floating establishment / O type / Hotel / Cat 4 / Autonomous / FE-COMF(1-2) / Green passport** • **MC**
Hospital	✠ **I 10** **Floating establishment / U type / Hospital / Cat 2 / Clean-unit** ✠ **MC**

1.3 Characters of construction for hull and machinery installations

1.3.1 General

The characters of construction refer to the original condition of the unit. However, the Society may change the character of construction where the unit is subjected to repairs, conversion or alterations.

1.3.2 Character ✠

The character ✠ heading the class designation indicates that hull, machinery, as well as special equipment and installations included in the classification, have been constructed:

- under the survey of and in accordance with the Rules of the Society at the Building Yard and/or at subcontractors supplying construction components/hull sections, as applicable
- with certification by the Society of components and materials requiring inspection subject to the Society's construction Rules.

1.3.3 Character <u>✠</u>

The characters <u>✠</u> will be assigned if the unit has been designed and constructed in accordance with the Rules and under supervision of another classification Society and is subsequently - or at a later date - classed with the Society, see Tab 2.

1.3.4 Character •

The character • will be assigned to the relevant part of the unit, where the procedure for the assignment of classification is other than those detailed in [1.3.2] and [1.3.3], but however deemed acceptable, see Tab 2.

1.3.5 Character MC

Under the same conditions, one of the characters defined in [1.3.2], [1.3.3] and [1.3.4] is assigned, followed by the character **MC**, to the classed machinery installation.

1.3.6 Special equipment

Generally, one of the construction characters (✠, <u>✠</u> or •) is assigned, under the same conditions and followed by the appropriate character, to any special equipment for which a classification certificate is issued.

e.g.: ✠ **Crane**

1.4 Characters of class and compliance with the Rules

1.4.1 If the unit's hull is found to comply with the Society's Rules, or Rules of another classification Society or other Rules considered to be equivalent, the character of class will be **I**.

A lower degree of compliance may be indicated, in exceptional cases, by the character of class **II**. In this case, the class may be maintained for shorter class periods or with shorter survey intervals. See Tab 3.

1.5 Character of class period

1.5.1 The character **p** indicates the duration of the nominal class period in years.

Normally, **p** = **10**

The nominal class period may be extended in compliance with Ch 2, Sec 2, [1.6.2].

The nominal class period can be reduced in exceptional cases and for a limited time, if the unit does not fully comply with the Rules but has been allowed to operate under restrictions. See Tab 3.

1.6 Type and service notation

1.6.1 The type and service notation Floating establishment is assigned to stationary berthed non propelled floating units equipped for missions such as activities intended for public, accommodation facilities, etc., complying with the requirements of this Rule Note.

Table 2 : Hull and machinery - Mode of survey and certification

Component	Character	Rule requirements	Example
Hull	✠	Units built under the supervision of the Society and with certification of components and materials in accordance with the Rules.	✠ **I 5**
	<u>✠</u>	Units built under the supervision of another classification Society and which have been assigned a class equivalent to the Society's Rules of classification.	<u>✠</u> **I 5**
	•	Units built under the supervision of the Society in accordance with the Rules but, e.g., without inspection by the Society of components and materials which, however, deemed to be acceptable. It is the responsibility of the Building Yard, Owner or Other Interested Party to ascertain that the materials and equipment used in the unit's construction satisfactorily meet the Rules requirements. Depending on particular conditions or unit notations, inspection of materials and components by the Society may be required for essential services.	• **I 5**
	•	In the event of admission to class or classification after construction of not classed units.	• **I 5**
Machinery	✠, etc.	Same characters, followed by **MC**	<u>✠</u> **MC**

Table 3 : Hull - Characters of class and characters of class period

Hull	Meaning of the characters
Class	The character of class indicates the maintenance condition of the unit's hull in relation to the requirements of the construction Rules: **I** : For units found to meet the construction and scantling requirements **II** : For units that do not meet in full some construction or scantling requirements but, however, are deemed acceptable to be entered in the Register of inland vessels
Class period (**p**)	Thecharacter **p**, following the character of class, indicates the duration of the class period in years. Examples: **10**, **5**

1.7 Additional service features

1.7.1 General

The type and service notation **Floating establishment** will be completed by additional service features, giving further precision regarding the type or service of the unit, for which specific rule requirements are applied.

1.7.2 At least, one additional service feature describing the unit type in compliance with Tab 4 will be assigned. Specific requirements applicable to each unit type are developed in Part D, Chapter 1. See also Ch 1, Sec 1, [1.1.7].

1.7.3 The type and service notation **Floating establishment** will be also completed by additional service features described in [1.7.4] to [1.7.7], as applicable, depending upon the:

- number of persons admitted (public and staff)
- mode of operation in relation with energy supply
- hull structural configuration
- hull materials.

1.7.4 Category of unit

Depending on the number of persons (public and staff) admitted on board, each floating establishment will be assigned an additional service feature **Cat i** , where **i** is the category number defined in Ch 1, Sec 1, Tab 1.

1.7.5 Mode of operation

Where, regarding energy supply (electrical power, water, heating and air conditioning systems) and fire safety management, the unit is fully independent with respect to shore systems, the floating establishment will be assigned the additional service feature **Autonomous**.

1.7.6 Type of construction

Based on the different types of construction of the hull of each unit, one of the following additional service features will be added to the type and service notation **Floating establishment**:

- **Double hull**, to units fitted with inner bottom and inner sides contributing to the hull girder strength and complying with the applicable rule requirements.

  Convenient accesses to all double bottom and side tank spaces are to be provided for inspection.

- **With double bottom**, to units fitted with inner bottom contributing to the hull girder strength and complying with the applicable rule requirements.

  Convenient accesses to all double bottom spaces are to be provided for inspection.

- **With double sides**, to units fitted with inner sides contributing to the hull girder strength and complying with the applicable rule requirements.

  Convenient accesses to all side tank spaces are to be provided for inspection.

1.7.7 Special considerations for hull materials

If units are constructed of normal strength hull structural steel, this will not be specially indicated. If other materials are employed for the hull, this will be indicated in the notations in the class certificate, e.g.:

- **HS** for higher strength hull structural steel
- **AL** for aluminium
- **C** for composite materials such as FRP
- **W** for wood
- **CR** for concrete.

Table 4 : Additional service feature defining unit types

Unit type	Includes floating establishments:	Reference in NR580
J type	equipped with reception facilities for senior and persons with reduced mobility	Pt D, Ch 1, Sec 1
L type	intended to be operated as cinemas, theatre, meeting rooms or as multipurpose rooms for similar activities	Pt D, Ch 1, Sec 2
M type	intended to be operated as shops, shopping malls or similar activities	Pt D, Ch 1, Sec 3
N type	intended to be operated as restaurants, bars or similar activities	Pt D, Ch 1, Sec 4
O type	intended to be operated as hotels or similar activities	Pt D, Ch 1, Sec 5
P type	intended to be operated as dance halls, play rooms or similar activities	Pt D, Ch 1, Sec 6
R type	intended to be operated as training centers, vacation centers, day care centers or similar activities	Pt D, Ch 1, Sec 7
S type	intended to be operated as libraries, documentation centers or similar activities	Pt D, Ch 1, Sec 8
T type	intended to be operated as showroom or similar activities	Pt D, Ch 1, Sec 9
U type	intended to be operated as hospitals, dispensaries or similar activities	Pt D, Ch 1, Sec 10
V type	intended for worship or similar activities	Pt D, Ch 1, Sec 11
W type	intended to be operated as administration, offices or similar activities	Pt D, Ch 1, Sec 12
X type	intended to be operated as sport centers or similar activities	Pt D, Ch 1, Sec 13
Y type	intended to be operated as museum or similar activities	Pt D, Ch 1, Sec 14

Table 5 : List of additional class notations

Additional class notation	Reference in this Section	Applicable requirements in NR580 or other Rule Note	Remarks
AWT	[1.8.7]	Pt D, Ch 2, Sec 5, [5]	
Clean-unit	[1.8.7]	Pt D, Ch 2, Sec 5, [4]	
FE-COMF(N-V)	[1.8.2]	Pt D, Ch 2, Sec 1	
FE-Damage stability	[1.8.3]	Pt D, Ch 2, Sec 2	
FE-Equipped for wheeled vehicles	[1.8.4]	Pt D, Ch 2, Sec 3	
FE-Ice(40)	[1.8.6]	Pt D, Ch 2, Sec 4	
FE-Ice(30)	[1.8.6]	Pt D, Ch 2, Sec 4	
FE-Ice(20)	[1.8.6]	Pt D, Ch 2, Sec 4	
Green passport	[1.8.5]	NR528	
GWT	[1.8.7]	Pt D, Ch 2, Sec 5, [6]	
NDO-x days	[1.8.7]	Pt D, Ch 2, Sec 5, [7]	
NOX-x%	[1.8.7]	Pt D, Ch 2, Sec 5, [8]	
OWS-x ppm	[1.8.7]	Pt D, Ch 2, Sec 5, [9]	
SOX-x%	[1.8.7]	Pt D, Ch 2, Sec 5, [10]	

1.8 Additional class notations

1.8.1 General

An additional class notation expresses the classification of additional equipment or specific arrangement, which has been requested by the Interested Party.

The assignment of such an additional class notation is subject to the compliance with additional rule requirements, which are detailed in Part D, Chapter 2.

1.8.2 Comfort on board

The notations dealt with under this heading are relevant to the assessment of comfort on board units with regard to the noise and/or vibration.

The parameters which are taken into consideration for the evaluation of the comfort, such as the level of noise and/or the level of vibration, will be indicated in the relevant annex to the Certificate of Classification.

Units complying with the requirements defined in Pt D, Ch 2, Sec 1 are assigned the additional class notation **FE-COMF(N-V)**,

where:

N : Noise grade

N = **1**, **2** or **3**, "1" corresponding to the most comfortable noise level

V : Vibration grade

V = **1**, **2** or **3**, "1" corresponding to the most comfortable vibration level.

Example:

FE-COMF(1-2)

The assessment of noise and vibration levels is carried out through measurements.

The assignment of **FE-COMF(N-V)** may be done separately for public and staff spaces.

1.8.3 Damage stability

The additional class notation **FE-Damage stability** may be assigned to units for which the damage buoyancy file has been examined by the Society and found to satisfy the specific requirements of Pt D, Ch 2, Sec 2.

The certificate/attestation issued specifies the criteria considered for this examination and is to be annexed to the Certificate of Classification. The damage buoyancy and stability file is to be available on board.

The certificates/attestations issued for damage stability remain valid unless:

- the relevant structure, equipment or installations of the unit are modified or not kept in a satisfactory condition of maintenance and operation
- the conditions of operation of the unit differ from those taken into consideration for the examination
- the proper applicable documentation examined by the Society is not available on board
- the Certificate of Classification is not valid.

1.8.4 Equipped for wheeled vehicles

The type and service notation **Floating establishment** may be completed with the additional class notation **FE-Equipped for wheeled vehicles**, where the unit complies with the requirements stated under Pt D, Ch 2, Sec 3.

1.8.5 Green passport for unit recycling

The additional class notation **Green passport** may be assigned to units for which requirements intended to facilitate unit recycling have been applied, encompassing the identification, quantification and localization of materials which may cause harm to the environment and people when the fittings or equipment containing such materials are removed, or when the unit is recycled.

The requirements for the assignment and maintenance of this notation are given in NR528 Green passport.

1.8.6 Operation in ice environment

The following notations are relevant to units strengthened for operation in ice in accordance with the requirements given in Pt D, Ch 2, Sec 4:

a) **FE-Ice(40)**

The additional class notation **FE-Ice(40)** is assigned to units with such structure, machinery and other properties that they are capable of operating in broken ice not exceeding 40 cm in thickness

b) **FE-Ice(30)**

The additional class notation **FE-Ice(30)** is assigned to units with such structure, machinery and other properties that they are capable of operating in broken ice not exceeding 30 cm in thickness

c) **FE-Ice(20)**

The additional class notation **FE-Ice(20)** is assigned to units with such structure, machinery and other properties that they are capable of operating in broken ice not exceeding 20 cm in thickness.

1.8.7 Pollution prevention

The following notations are assigned to units fitted with equipment and arrangements enabling them to control and limit the emission of polluting substances in the water and the air:

a) **Clean-unit**

The additional class notation **Clean-unit** is assigned to units fitted with equipment and arrangements as required in Pt D, Ch 2, Sec 5, [4].

b) **AWT**

The additional class notation **Clean-unit AWT** is assigned when, in addition to the above, the unit is fitted with an Advanced Wastewater Treatment as required in Pt D, Ch 2, Sec 5, [5].

c) **GWT**

The additional class notation **GWT** applies to units fitted with a Grey Water Treatment plant in accordance with the provisions of Pt D, Ch 2, Sec 5, [6].

d) **NDO-x days**

The additional class notation **NDO-x days** applies to units having sufficient onboard storage capacity for solid waste and liquid effluents, allowing the fully loaded unit to operate without discharging any substances into the water during x consecutive days (no discharge period), in accordance with the provisions of Pt D, Ch 2, Sec 5, [7].

e) **NOX-x%**

The additional class notation **NOX-x%** applies to units fitted with diesel engines having a weighted average NOx emission level not exceeding x% of limit, in accordance with the provisions of Pt D, Ch 2, Sec 5, [8].

f) **OWS-x ppm**

The additional class notation **OWS-x ppm** applies to units fitted with an Oily Water Separator capable of producing effluents having a hydrocarbon content not exceeding x ppm, in accordance with the provisions of Pt D, Ch 2, Sec 5, [9].

g) **SOX-x%**

The additional class notation **SOX-x%** applies to units using fuel oils complying with the criteria given in Pt D, Ch 2, Sec 5, [10].

1.8.8 Miscellaneous additional class notations

When the unit's hull or essential parts have been constructed in accordance with a design, for which sufficient experience is not available, the Society may also define other notations by means of provisional requirements and guidelines, which may then be published in the form of tentative rules. The Society decides at what intervals the required periodical surveys are to be carried out.

Part A
Classification and Surveys

Chapter 2
CLASSIFICATION

SECTION 1 ASSIGNMENT OF CLASS

1 General

1.1

1.1.1 Class is assigned to a unit upon a survey, with the associated operations, which is held in order to verify whether it is eligible to be classed on the basis of the Rules of the Society. See Ch 1, Sec 1, [1.4.1] and Ch 1, Sec 1, [1.4.2].

This may be achieved through:

- the completion of a new building, during which a survey has been performed
- a survey when the unit changes class between classification Societies, or
- a specific admission to class survey, in cases where a unit is not classed at all.

1.1.2 The assignment of class is to comply with the procedure developed in NR217, Pt A, Ch 2, Sec 1, where the terminology "vessel" is to be replaced by "unit".

SECTION 2 MAINTENANCE OF CLASS

1 General principles of surveys

1.1 Survey types

1.1.1 Classed units are submitted to surveys for the maintenance of class. These surveys include the class renewal survey, intermediate and possible quarter term survey, bottom survey (either survey in dry condition or in-water survey), boiler survey, and surveys for the maintenance of additional class notations, where applicable. Such surveys are carried out at the intervals and under the conditions laid down in this Rule Note.

The different types of periodical surveys are summarized in Tab 1. The intervals at which the periodical surveys are carried out are given in the items referred to in the second column of Tab 1. The relevant extent and scope are given in Ch 3, Sec 1 for all units.

Where there are no specific survey requirements for additional class notations assigned to a unit, equipment and/or arrangements related to these additional class notations are to be examined, as applicable, to the Surveyor's satisfaction at each class intermediate or renewal survey for the class.

The surveys are to be carried out in accordance with the relevant requirements in order to confirm that the hull, machinery, equipment and appliances comply with the applicable Rules and will remain in satisfactory condition based on the understanding and assumptions mentioned in NR217, Pt A, Ch 2, Sec 1, [6.2].

Table 1 : List of periodical surveys

Type of survey	Ref. in this Section	Ref. to scope of survey
Class renewal - hull	[1.5.2]	Ch 3, Sec 1, [3]
Class renewal - machinery	[1.5.2]	Ch 3, Sec 1, [3]
Class renewal - additional class notations	[1.5.2]	Ch 3, Sec 2
Quarter term - hull **(1)**	[1.5.3]	Ch 3, Sec 1, [1]
Quarter term - machinery **(1)**	[1.5.3]	Ch 3, Sec 1, [1]
Intermediate - hull	[1.5.4]	Ch 3, Sec 1, [1]
Intermediate - machinery	[1.5.4]	Ch 3, Sec 1, [1]
Intermediate - additional class notations		Ch 3, Sec 2
Bottom	[1.5.5]	Ch 3, Sec 1, [3.2]
(1) Not applicable to units being assigned a class period **p** ≤ 5		

Where the conditions for the maintenance of type and service notation **Floating establishment** and additional class notations are not complied with, the type and service notation and/or the additional class notations, as appropriate, will be suspended and/or withdrawn in accordance with the applicable requirements given in Ch 2, Sec 3, [1].

It is understood that requirements for surveys apply to those items that are required according to the Rules.

Unless specified otherwise, any survey other than bottom survey may be effected by carrying out partial surveys at different times to be agreed upon with the Society, provided that each partial survey is adequately extensive. The splitting of a survey into partial surveys is to be such as not to impair its effectiveness.

1.2 Change of periodicity, postponement or advance of surveys

1.2.1 The Society reserves the right, after due consideration, to change the periodicity, postpone or advance surveys, taking into account particular circumstances.

When a survey becomes due, the following requirements apply.

In the case of a class renewal survey, the Society may grant an extension provided there is documented agreement to such an extension and class extension surveys are performed prior to the expiry date of the class certificate, and the Society is satisfied that there is justification for such an extension.

a) Class renewal survey

   In the case of extension of the period of class, the following apply:

   - the total period of extension Δp shall in no case be longer than one year after the original limit date of the class renewal survey
   - the new period of class will commence the following day after which the extension period expires.

b) Intermediate survey

   In the case of intermediate survey, as a rule, no postponement is granted. The survey is to be completed within its prescribed windows.

c) In the case of all other periodical surveys and conditions of class/recommendations, extension or postponement may be granted, provided there is sufficient technical justification for such an extension or postponement.

1.2.2 Extension of scope of survey

The Society may extend the scope of the provisions in Ch 3, Sec 1 and Ch 3, Sec 2 which set forth the technical requirements for surveys, whenever and so far as considered necessary, or modify them in the case of special units or systems.

The extent of any survey also depends upon the condition of the unit and its equipment. Should the Surveyor have serious doubts as to the maintenance or condition of the unit or its equipment, or be advised of any deficiency or damage which may affect the class, then further examination and testing may be conducted as considered necessary.

1.2.3 General procedure of survey

The general procedure of survey consists in:

- an overall examination of the parts of the unit covered by the Rules
- at random checking of the selected items covered by the Rules
- attending tests and trials, where applicable and deemed necessary by the Surveyor.

When a survey results in the identification of significant corrosion, structural defects or damage to hull, machinery and/or any piece of its equipment which, in the opinion of the Surveyor, affect the unit's class, remedial measures may be required to be implemented before the unit continues in service.

The Society's survey requirements cannot be considered as a substitute for specification and acceptance of repairs and maintenance, which remain the responsibility of the Owner.

1.3 Definitions and procedures related to surveys

1.3.1 General

For definitions and procedures related to surveys, refer to NR217, Pt A, Ch 2, Sec 2, [2], where:

- the terminology “vessel” is to be replaced by “unit”
- the corrosion margins are given in Pt B, Ch 2, Sec 4, [1].

1.4 Documentation of surveys, confirmation of class

1.4.1 General

The records of each survey, as well as any requirements upon which maintenance of class has been made conditional, will be entered into the respective survey statement/certificate.

By his signature in the certificate and other documents the Surveyor certifies what he himself has seen and checked during the particular survey.

In the Register the dates of the surveys will be indicated.

On request, the class status may be confirmed in writing by a separate certificate/attestation issued by the Society.

Where defects are repaired provisionally only, or where the Surveyor does not consider immediate repair or replacement necessary, the unit's class may be confirmed for a limited period. Cancellation of such limitations will have to be indicated in the survey statement/certificate.

1.4.2 Validity of certificates/attestations

If for some reason a unit's class has expired or has been withdrawn by the Society, all certificates/attestations issued by the Society will automatically become void. If subsequently the class is renewed or reassigned, the validity of these certificates/attestations may be revived within the scope of their original period of validity, provided that all surveys meanwhile having fallen due have been carried out to the satisfaction of the Surveyor.

1.4.3 Endorsement of certificate of classification

When surveys are satisfactorily carried out, the certificate of classification is generally endorsed accordingly, with the relevant entries.

1.5 Periodical surveys

1.5.1 General

The periodical surveys listed in this sub-article are to be conducted for the hull, machinery including electrical installations as well as special equipment and installations included in the classification of the a floating unit.

If, for some obvious reason, e.g. a temporary out-of-service condition of certain equipment, parts included in the classification cannot be surveyed, this will be noted in the survey statement/certificate.

Where applicable Regulations impose inspection intervals deviating from the class related intervals, the intervals will be harmonized in the individual case to reduce the number of single surveys, where possible.

In principle elements covered by the classification and submitted to a class renewal survey on a date different from the date of the periodical class renewal survey of the unit, are to be re-examined **p** years after the previous survey.

1.5.2 Class renewal survey

Class renewal survey - also called special survey - is to be carried out at the intervals **p** indicated by the character of class period.

Upon request, in exceptional cases, extension of the class period may be granted by the Society. See [1.6.2].

A class renewal survey may be carried out in several parts. The survey may be commenced at the last year during the class period. Considering Ch 3, Sec 1, [3.1.2], the total survey period of the class renewal survey is not to exceed 12 months, except under special circumstances and by prior agreement from the Society.

The new period of class will commence:

- the following day after which the previous class expires, provided that the class renewal survey has been completed within the 3 months preceding that date
- at the date on which the class renewal survey has been completed, if this is the case more than 3 months before expiry of the previous class.

The class renewal survey is in principle to be held, in addition to the inspections and checks to be carried out on occasion of the quarter term surveys, when the unit is in dry dock or on a slipway, unless a dry docking survey has already been carried out within the admissible period. See [1.5.2] and Ch 3, Sec 1, [3.2].

1.5.3 Quarter term survey

The quarter term survey falls due every **p**/4 years.

The survey has to be carried out within a time interval from 3 months before to 3 months after the date corresponding to **p**/4.

The quarter term survey does not apply to units being assigned a period of class **p** ≤ 5.

1.5.4 Intermediate survey

The intermediate survey falls due at half the nominal time interval between two class renewal surveys, i.e. every **p**/2 years.

The survey has to be carried out within a time interval from 6 months before to 6 months after the date corresponding to **p**/2.

1.5.5 Bottom survey

Bottom survey means the examination of the outside of the unit's bottom and related items. This examination may be carried out with the unit either in dry dock (or on a slipway) or afloat: the survey will be referred to as dry-docking survey in the former case and as in-water survey in the latter case.

The Owner is to notify the Society whenever the outside of the unit's bottom and related items can be examined in dry dock or on a slipway.

1.5.6 Links between anniversary dates and surveys

The links between the anniversary dates and the surveys are given in Fig 1 for a class period **p** = 10 and in Fig 2 for a class period **p** = 5.

Figure 1 : Links between anniversary dates and surveys - p = 10

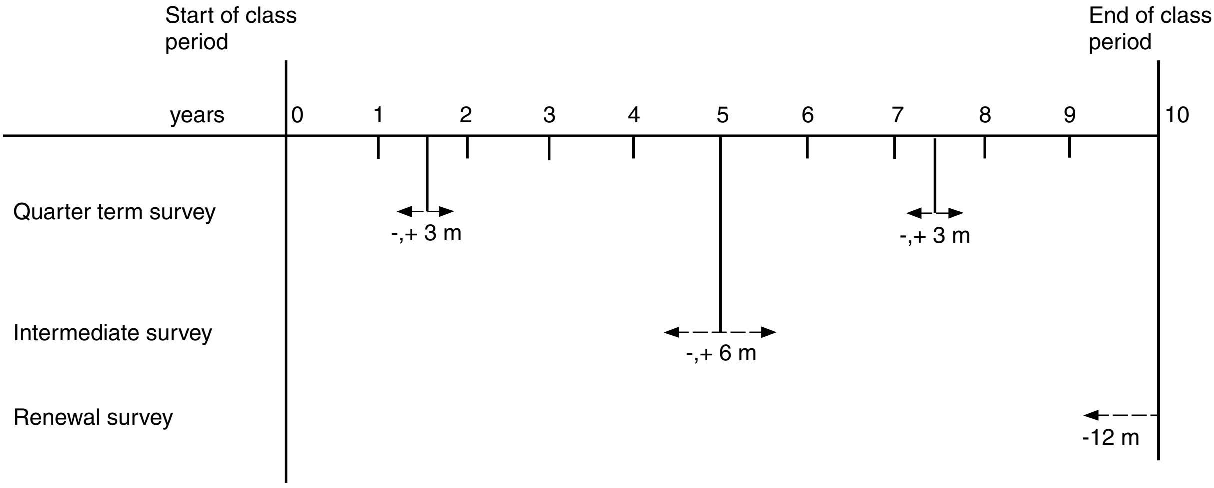
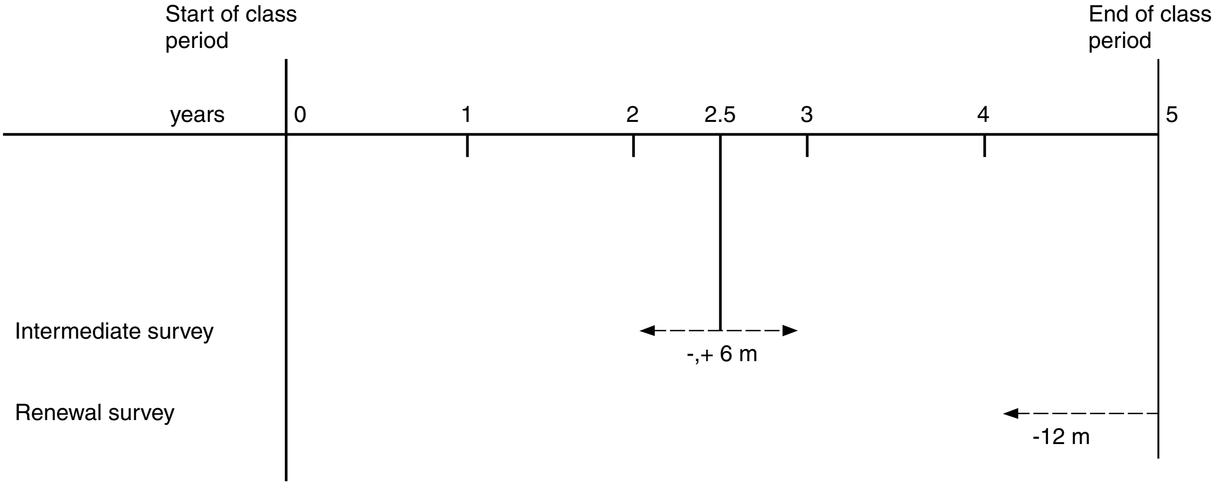


Figure 2 : Links between anniversary dates and surveys - p = 5



1.6 Non-periodical surveys

1.6.1 General

In addition to the periodical surveys, units are to be submitted to non-periodical surveys such as occasional surveys whenever the circumstances so require.

Occasional surveys are carried out at the time of, for example:

- updating of classification documents, e.g. change of the Owner, name of the unit, country of registry
- damage or suspected damage
- repair or replacement work
- alterations or conversion
- extraordinary surveys as parts of the Society's quality assurance system
- postponement of surveys or of conditions of class/recommendations.

1.6.2 Class extension surveys

On Owner's special request and following surveys of hull and machinery afloat, the Society may extend the class by no more than 12 months in total, provided that the surveys in the scope of a **p**/2 - intermediate survey at least, show that hull and machinery, including electrical installations, are in unobjectionable condition.

1.7 Surveys in accordance with registration country Regulations

1.7.1 General

All activities outlined in [1.7.2] and, where applicable, issuance of relevant certificates/attestations are likewise subject to the respective latest edition of Society's General Conditions.

1.7.2 Society's intervention

Where surveys are requested by the Owner on account of corresponding laws and Regulations, the Society will carry them out by order or within the framework of official order, acting on behalf of the Authorities concerned, based on the respective provisions.

Where possible, such surveys will be carried out simultaneously with the class surveys.

1.8 Lay-up and recommissioning of laid-up units

1.8.1 Lay-up and recommissioning of laid-up units are subject to the requirements of NR217, Pt A, Ch 2, Sec 2, [8].

SECTION 3 SUSPENSION AND WITHDRAWAL OF CLASS

1 General

1.1

1.1.1 The class may be discontinued either temporarily or permanently. In the former case it is referred to as "suspension" of class, in the latter case as "withdrawal" of class. In both cases, the class is invalidated in all respects.

If, for some reason, the class has expired or has been withdrawn or suspended by the Society, this fact may be indicated in the Register.

1.1.2 If the Owner is not interested in maintenance of class of the unit or any of its special equipment and installations classed, or if conditions are to be expected under which it will be difficult to maintain class, the Society will have to be informed accordingly. The Society will decide whether the certificate will have to be returned and class suspended or withdrawn. Where only special equipment and installations are concerned, the corresponding notation will be withdrawn and the certificate amended accordingly.

1.1.3 Class may also be suspended if a unit is withdrawn from active service for a longer period.

1.1.4 The discontinuance of class is to be governed by the procedure developed in NR217, Pt A, Ch 1, Sec 1, [3], where the terminology “vessel” is to be replaced by “unit”.

SECTION 4 CLASSIFICATION PROCEDURES

1 General

1.1 Classification of new building

1.1.1 The written order for classification is to be submitted to the Society, if needed, by the Building Yard, the Other Interested Party or by the Prospective Owner, using the form provided by the Society. It should be clearly agreed between the parties concerned, e.g. in the building contract, which party will be responsible for compliance with the Society's Rules and Guidelines and other Rules and Regulations to be applied.

Where orders for the production of components are placed with subcontractors, the Society will have to be advised accordingly indicating the scope of the subcontract. The Building Yard, Prospective Owner and Other Interested Party are responsible for observance of the Rules, Guidelines and Regulations by subcontractors.

When particulars already approved by the Society for previous units built under supervision of the Society are incorporated in the design of the new building, this should be specifically stated in the order for classification. Amendments to the construction Rules having been introduced meanwhile shall be taken into account.

1.1.2 The classification procedures for new building is described in NR217, Pt A, Ch 1, Sec 2, [4.1], where the terminology “vessel” is to be replaced by “unit”.

1.2 Classification after construction of existing units

1.2.1 Units not originally built under supervision of the Society may be classed subsequently following the procedures described hereafter.

The Owner should contact the Society for the necessary arrangements. The Society is to be informed about the previous class status and period, as well as about any conditions of class/recommendations imposed by the previous classification Society. The written order for admission to class of existing units or special equipment including the required documents shall be formally addressed to the Society, if needed, using adequate forms.

1.2.2 The procedures for classification after construction of existing units is described in NR217, Pt A, Ch 1, Sec 2, [4.2], where the terminology “vessel” is to be replaced by “unit”.

SECTION 5 HULL SURVEY FOR NEW CONSTRUCTION

1 General

1.1

1.1.1 In this Section, the Building Yard is understood as acting directly or on behalf of the Party requesting classification.

1.1.2 When a hull construction is surveyed by the Society, the Building Yard is to provide all appropriate evidence required by the Society that the hull is built in compliance with the Rules and Regulations, taking account of the relevant approved/reviewed drawings.

1.1.3 The hull survey for new construction is to comply with the requirements of NR217, Pt A, Ch 2, Sec 2, [5], where the terminology "vessel" is to be replaced by "unit".

Part A
Classification and Surveys

Chapter 3
SURVEYS FOR MAINTENANCE OF CLASS

SECTION 1 SURVEYS FOR MAINTENANCE OF CLASS - ALL UNITS

1 Quarter term survey

1.1 General

1.1.1 The requirements of this Article apply to quarter term surveys of all units. The specific requirements for quarter term surveys related to additional class notations assigned to units are addressed in Ch 3, Sec 2.

1.1.2 A survey planning meeting is to be held prior to the commencement of the survey.

1.2 Hull and hull equipment

1.2.1 General

The main structural elements of the hull are to be subjected to a general visual inspection, as far as accessible. If applicable, ballast tanks, storage and engine rooms are to be surveyed at random, depending on the unit type, age and general condition. Where damages or excessive wastage affecting the class are suspected, the Surveyor is entitled to carry out further investigations as well as thickness measurements, if required.

The foundations and their substructure of special equipment, particularly on the main deck.

Compartments and rooms normally not accessible, or accessible only after special preparations, may be required to be opened for inspection, depending on the unit's age and available information about service conditions.

1.2.2 Ballast tanks

Depending on the unit's age, the Surveyor may require opening of ballast tanks for visual inspection, particularly if deterioration of the coating or excessive wastage has already been observed at previous surveys.

If the coating in such ballast tanks is found to be in poor condition (see Ch 2, Sec 2, [1.3.1]), maintenance of class is to be subject to the tanks in question being examined at annual intervals, and thickness measurements carried out as considered necessary.

If coating is to be partly or totally renewed, only approved coating is applicable in case of a repair. The whole working procedure including the surface preparation is to be documented.

1.2.3 Hatches and covers

Hatches and covers, bulkhead and hull doors, ramps and any openings in the outer shell are to be surveyed regarding structural integrity, as well as tightness and operability of all closures.

Additionally to the overall survey, the following structural members of side doors are to be thoroughly inspected:

- all hinges and the pertinent hydraulic cylinders in way of their securing points
- all securing elements of the locking devices and stoppers.

Where considered necessary by the Surveyor, additionally crack tests are to be carried out at structural members of side and end doors.

Essentially, the crack tests are to cover:

- main joining welds and their interfacial areas both on the unit's hull and on the doors
- highly stressed areas in way of the centres of rotation of the hinges
- highly stressed areas of the locking devices and their stoppers
- repair welding.

For crack detection, the dye penetration method or the magnetic particle inspection method is to be employed, and a test protocol is to be prepared.

1.3 Machinery and electrical installations

1.3.1 General

The machinery, including electrical installations, is to be subjected to the following surveys and operational checks:

- general inspection of machinery and boiler rooms, with special regard to the auxiliary engines, possible fire and explosion sources, and checking of emergency exits as to their free passage
- inspection and checking of the remote control, quick-closing/stopping devices of pumps, valves, ventilators, etc.
- random checking of the remote control and automation equipment
- inspection of the bilge system, including remote control actuators and bilge filling level monitors
- checking of the main and emergency power supply systems, including the switch gear and other important electrical installations
- survey of explosion-proof installations
- random inspection and checking of essential equipment, to the Surveyor's discretion.

1.3.2 Fire-extinguishing systems

a) General requirements

   The following items/systems are subject to inspection and/or testing, where applicable:

   - fire main system, including hoses and nozzles
   - gas fire-extinguishing system

- dry powder fire-extinguishing system
- foam fire-extinguishing system
- sprinkler system, including water mist sprinkler system
- water and/or foam drencher system
- any other fixed fire-extinguishing system provided
- portable fire extinguishers, mobile fire extinguishers, including portable foam application units
- fire detection and alarm systems
- emergency stops for ventilation fans, boiler forced draft fans, fuel transfer pumps, fuel oil purifiers
- quick-closing fuel valves
- fire closures, fire dampers, etc.
- fireman's outfits, if required.

b) Fire hoses and nozzles

Fire hoses and nozzles provided are to be included in the testing of the fire main system, to the Surveyor's discretion.

c) Fixed fire-extinguishing systems

Fixed fire-extinguishing systems, such as gas, foam, dry powder or water mist systems, including gas cylinders, are subject to maintenance every 2 years, or according to applicable regulations.

On the occasion of these inspections, all hose assemblies are to be subjected to a visual check. All hose assemblies made of synthetic rubber are to be replaced according to the manufacturer's instructions.

The installation, maintenance, monitoring and documentation of fixed fire-extinguishing systems according to Statutory Regulations, for the engine room, pump room and all spaces containing essential equipment, such as switchboards, compressors, etc., and for the refrigeration equipment, if any, shall only be performed by recognized specialized companies.

d) Portable and mobile fire extinguishers

Portable and mobile fire extinguishers are subject to inspection by an approved or recognized specialized company every 2 years, or according to applicable regulations. Maintenance and eventual pressure testing are to be carried out as appropriate in accordance with the manufacturer's instructions or applicable Rules. Each extinguisher is to be provided with a label showing the date of inspection and the name and signature of the approved or recognized specialized company.

A protocol of the inspections and maintenance work carried out is to be kept on board.

e) Foam concentrate

Foam concentrate for fixed foam fire-extinguishing systems is to be examined not later than 3 years after filling into the system, and yearly thereafter. The examination is to be performed by the manufacturer or by an independent recognized laboratory. Reports are to be presented to the Surveyor. Manufacturer's certificates stating the properties of the foam concentrate are to be available on board for reference.

The foam concentrate for the portable foam applicators is to be renewed on the occasion of each class renewal.

More extensive regulations regarding other inspection intervals/performance of the tests should be observed.

1.3.3 Machinery

a) Measurement

The measurement of crank web deflection of diesel engine(s) is generally to be performed unless it can be proved by valid protocols that it has been carried out recently.

b) Operational tests

In addition to [1.3.1], the following system components are to be subjected to operational tests:

- emergency generating set, including emergency switchboard (where applicable)
- emergency bilge valve(s)
- bilge and ventilation systems
- drainage facilities of starting-air and control-air receivers
- general operational test of the machinery and electrical installations to demonstrate unrestricted operability, as indicated by the Surveyor.

c) Monitoring equipment

The monitoring equipment and the automated functions of the machinery installation are to be subjected to operational trials under service conditions.

1.3.4 Electrical installations and equipment

The Surveyor is to check the good condition, particularly the earthing of the electrical equipment, and the satisfactory operating condition of the entire electrical installation. If he judges it necessary, the insulation level of the electrical installations is to be checked.

1.3.5 Automated installations

The good working of the fire detectors and bilge floating alarms is to be checked. The satisfactory operation of some selected equipment (alarms, safety equipment, automatic equipment, etc.) is to be checked.

2 Intermediate survey

2.1 General

2.1.1 The intermediate survey is to include examination and checks on a sufficiently extensive part of the structure to show that the structures of the unit are in satisfactory condition so that the unit is expected to operate until the end of the current period of class, provided that the unit is properly maintained and other surveys for maintenance of class are duly carried out during this period.

2.1.2 For units being assigned a class period **p** ≤ 5, the intermediate survey is to be carried out according to [1].

2.1.3 For units being assigned a class period **p** > 5, the intermediate survey is to include all the inspections and checks required for quarter term surveys.

Note 1: More extensive Regulations of the country where the unit is registered are to be observed.

2.1.4 The requirements of this Article apply to all units. Additional requirements may have to be observed for particular unit types, at the request of the Owner or in connection with the manufacturer's recommendations for special equipment.

2.2 Hull

2.2.1 The requirements given in Tab 1 for the survey and testing of water ballast spaces and other hull spaces are to be complied with.

3 Class renewal survey

3.1 General

3.1.1 The requirements of this Article apply to class renewal surveys of all units. The specific requirements for class renewal surveys related to additional class notations assigned to units are addressed in Ch 3, Sec 2.

3.1.2 A survey planning meeting is to be held prior to the commencement of the survey.

3.1.3 The class renewal survey is to include sufficiently extensive examination and checks to show that the structures, machinery, systems, equipment and various arrangements of the unit are in satisfactory condition or restored to such condition as to allow the unit to operate for the new period of class of **p** years assigned, provided that the unit is properly maintained and operated and that other surveys for maintenance of class are duly carried out during this period.

The examinations of the hull are to be supplemented by thickness measurements and testing as required in [3.5] and [3.6], to ensure that the structural integrity remains effective. The aim of the examination is to discover substantial corrosion, significant deformation, fractures, damages or other structural deformation that may be present.

3.1.4 The Owner is to provide the necessary facilities to enable this class renewal survey. The conditions for survey are to be met (see Ch 2, Sec 2, [1.3.1]).

3.2 Bottom survey in dry condition

3.2.1 General

For the survey, the unit is to be placed on sufficiently high and secure blocks, so that all necessary examinations can be carried out in a satisfactory manner. It may be necessary to clean the bottom and outer shell and/or remove rust from some areas, to the Surveyor's satisfaction.

For units of unusual characteristics or engaged on special services, means of underwater inspection equivalent to the bottom survey in dry condition may be considered as an alternative by the Society, particularly when a suitable high resistance paint is applied to the underwater portion of the hull.

The underwater inspection is to be performed under the conditions set out in NR217, Pt A, Ch 3, Sec 5, [3].

3.2.2 The survey covers an examination of the bottom and side plates of the shell plating, including any attachments, the scuppers and water drain pipes, including their closures.

3.2.3 River valves and cocks are to be opened up for internal examination.

3.2.4 Thickness measurements of the outer shell plating, as and if required within the scope of the related class renewal survey, are to be carried out (refer to [3.6]), if not already done within 12 months before the end of class period.

3.3 Decks, hatch covers and equipment

3.3.1 Decks are to be examined, particular attention being given to the areas where stress concentration or increased corrosion are likely to develop, such as hatch corners and other discontinuities of structure.

The sheathing of wood-sheathed steel decks may be removed, at the Surveyor's discretion, in the case of doubt as to the condition of plating underneath.

Due attention is to be given to the examination in way of side openings and related shell and inner doors.

3.3.2 The survey of hull equipment is to cover the connection of masts and standing rigging to the hull structure, as well as condition of structure underneath.

Table 1 : Requirements for internal examination of integral (structural) tanks at class renewal survey

Tank	Age of unit (in years at time of class renewal survey)			
	age ≤ 10	10 < age ≤ 20	20 < age ≤ 30	age > 30
Water ballast tanks (all types)	all	all	all	all
Fresh water	none	one	all	all
Fuel oil bunker tanks:	none	none	one	one
Lubricating oil tanks	none	none	none	one

Note 1: Independent non-structural tanks located in machinery spaces are to be externally examined; the relevant fittings, with particular regard to the remote control shut-off valves under hydrostatic head, are to be externally examined to check the efficiency of manoeuvres and the absence of cracks or leakage.
Note 2: The extent of the survey of tanks dedicated to liquids other than those indicated in the present Table is to be considered by the Society on a case-by-case basis according to the nature of the liquids.
Note 3: If a selection of tanks is accepted to be examined, then different tanks are to be examined at each class renewal survey, on a rotational basis. Tanks not internally examined may be examined externally from accessible boundaries.

3.3.3 All bilge and ballast piping systems are to be examined and operationally tested to working pressure to the attending Surveyor's satisfaction to ensure that tightness and condition remain satisfactory.

3.4 Dry compartments

3.4.1 Cofferdams, pipe tunnels and duct keels, void spaces and other dry compartments which are integral to the hull structure are to be internally examined, ascertaining the condition of the structure, bilges and drain wells, sounding, venting, pumping and drainage arrangements.

3.4.2 Machinery spaces are to be internally examined, ascertaining the condition of the structure. Particular attention is to be given to tank tops, shell plating in way of tank tops, brackets connecting side shell frames and tank tops, and bulkheads in way of tank tops and bilge wells. Particular attention is to be given to the river suctions, river water cooling pipes and overboard discharge valves and their connections to the shell plating. Where wastage is evident or suspected, thickness measurements are to be carried out, and renewals or repairs effected when wastage exceeds allowable limits.

3.5 Tanks

3.5.1 The type and number of tanks to be internally examined at each class renewal survey are detailed in Tab 1, according to the age of the unit.

This internal examination is to ascertain the condition of the structure, bilges and drain wells, sounding, venting, pumping and drainage arrangements, including piping systems and their fittings. Due attention is to be given to plating or double plates below the lower end of sounding and suction pipes.

Where the inner surface of the tanks is covered with cement or other compositions, the removal of coverings may be waived provided they are examined, found sound and adhering satisfactorily to the steel structures.

Note 1: Due attention is also to be given to fuel oil piping passing through ballast tanks, which is to be pressure tested when the unit is more than 10 years old.

3.5.2 For tanks used for water ballast, excluding double bottom tanks, where a hard protective coating is found in poor condition and it is not renewed, where soft coating has been applied or where a hard protective coating was not applied from the time of construction, the tanks in question are to be examined as applicable, at each quarter term survey, for units being assigned a class period **p** > 5, or at each intermediate survey, for units being assigned a class period **p** ≤ 5. Thickness measurements are to be carried out as deemed necessary by the Surveyor.

When such breakdown of hard protective coating is found in water ballast double bottom tanks and it is not renewed, where a soft coating has been applied, or where a hard protective was not applied from the time of construction, the tanks in question may be examined as applicable, at each quarter term survey, for units being assigned a class period **p** > 5, or at each intermediate survey, for units being assigned a class period **p** ≤ 5. When considered necessary by the Surveyor, or where extensive corrosion exists, thickness measurements are to be carried out.

3.5.3 Boundaries of double bottom, deep, ballast, peak and other tanks, both integral and independent tanks, are to be tested in compliance with Pt B, Ch 8, Sec 3, [1], under test pressures defined in Pt B, Ch 3, Sec 3, [3].

3.5.4 Boundaries of fuel oil, lube oil and fresh water tanks are to be tested with a head of liquid to the highest point that liquid will rise under service conditions. Tank testing of fuel oil, lube oil and fresh water tanks may be specially considered, based on a satisfactory external examination of the tank boundaries, and a confirmation from the Owner stating that the pressure testing has been carried out according to the requirements with satisfactory results. The Surveyor may extend the testing as deemed necessary.

3.6 Thickness measurements

3.6.1 General

The thickness measurements required by the Rules consist of:

- systematic thickness measurements, i.e. measurements of different parts of the structure in order to assess the overall and local strength of the unit
- measurements of suspect areas (see Ch 2, Sec 2, [1.3.1])
- additional measurements on areas determined as affected by substantial corrosion (see Ch 2, Sec 2, [1.3.1]).

3.6.2 Extent

The extent of thickness measurements is detailed in Tab 2, according to the age of the unit. The Surveyor may extend the thickness measurements as deemed necessary. When thickness measurements indicate substantial corrosion, the extent of thickness measurements is to be increased to determine areas of substantial corrosion in accordance with Tab 3. These extended thickness measurements are to be carried out before the survey is credited as completed.

Thickness measurement locations are to be selected to provide the best representative sampling of areas likely to be the most exposed to corrosion, considering space history and arrangement and condition of protective coatings.

Thickness measurements of internals may be specially considered by the Surveyor if the hard protective coating is in good condition.

3.6.3 Reduction of thickness measurements

The extent of thickness measurements may be reduced, provided, during the close-up examination, the Surveyor satisfies himself that there is no structural diminution and the protective coating, where applied, continues to be effective.

3.6.4 Extension of thickness measurements

The Surveyor may extend the scope of the thickness measurements, as deemed necessary. This applies especially to areas with substantial corrosion.

3.6.5 Transverse sections

Transverse sections are to be chosen where largest corrosion rates are suspected to occur or are revealed by deck plating measurements.

Table 2 : Requirements for thickness measurements at class renewal survey

Age of unit (in years at time of class renewal survey)			
age ≤ 10	10 < age ≤ 20	20 < age ≤ 30	age > 30
Suspect areas	Suspect areas	Suspect areas	Suspect areas
	Within 0,5L amidships: • selected deck plates • one transverse section • selected bottom/inner bottom plates • selected side shell plates	Within 0,5L amidships: • each exposed deck plate • two transverse sections • selected tank top plates • each bottom/inner bottom plates • each side shell plate • selected transverse and longitudinal bulkheads **(1)**	Within 0,5L amidships: • each deck plate • three transverse sections • each bottom/inner bottom/tanktop plate • each side shell plate • all transverse and longitudinal bulkheads **(1)**
		Outside 0,5L amidships: • selected deck plates • selected side shell plates • selected bottom plates	Outside 0,5L amidships: • each deck plate • each side shell plate • each bottom plate
	End bulkheads, machinery space bulkheads **(1)** **(2)**		All transverse and longitudinal bulkheads outside 0,5L amidships **(1)** **(2)**
	In machinery space **(2)**: • river chests • river water manifold • duct keel or pipe tunnel plating and internals		
		Selected internal structure such as ballast tanks, floors and longitudinals, transverse frames, web frames, deck beams, girders, etc. Measurements may be increased if the Surveyor deems it necessary	

(1) Including plates and stiffeners.
(2) Measurements may be waived or reduced after satisfactory visual examination, when such bulkheads form the boundaries of dry void spaces or river chests, etc. and are found in good condition.

Table 3 : Guidance for additional thickness measurements in way of substantial corrosion areas

Structural member	Extent of measurements	Pattern of measurements
Plating	Suspect areas and adjacent plates	5-point pattern over 1 square metre
Stiffeners	Suspect areas	3 measurements, each in line across web and flange

3.6.6 Substantial corrosion and suspect areas

Where special reasons exist, the Surveyor may demand thickness measurements to be carried out already on the occasion of the first class renewal (unit age ≤ 5 years), also outside the area of 0,5 L amidships. The same applies in the case of conversion or repair of a unit.

3.7 Additional inspection and check for units of age ≤ 10 years

3.7.1 Equipment, deck openings, etc.

This class renewal survey also covers other parts essential for the safety of the unit, such as watertight doors, sluice valves, air and sounding pipes, gas-freeing, companionways, hatches, scuppers and water drain pipes with their valves, fire-protecting arrangements and masts.

3.7.2 Machinery space structure

Particular attention is to be given to tank tops, shell plating in way of tank tops, brackets connecting side shell frames to tank tops, engine room bulkheads in way of tank tops and the bilge wells. Where wastage is evident or suspected, thickness measurements are to be carried out.

3.8 Additional inspection and check for units such that 10 years < age ≤ 20 years

3.8.1 The requirements for class renewal survey of units belonging to this age range include those applying to units aged up to 10 years. Additionally, the investigations in [3.8.2] are to be carried out.

3.8.2 The structural parts behind ceilings, floor coverings and insulation are to be examined, as required by the Surveyor and depending on the general condition of the unit. See also [3.9.2].

3.9 Additional inspection and check for units of age > 20 years

3.9.1 The requirements for class renewal survey of units aged more than 20 years include those applying to units aged up to 20 years. Additionally, the investigations in [3.9.2] are to be carried out.

3.9.2 Ceilings, linings and insulation of all spaces, including steel ceiling adjacent to the shell plating and the inner bottom lining, are to be removed as indicated by the Surveyor, to enable the steel structure to be examined in detail.

The inner bottom lining may be partially removed at the Surveyor's discretion, to enable their assessment.

For class renewal surveys applying to units aged more than 30 years, the inner bottom covering are to be completely removed and the tank top is to be carefully cleaned, such as to enable proper assessment of the tank top condition.

The wall lining underneath windows in the outer shell is to be lifted as required by the Surveyor, so that the structure behind may be examined.

3.10 Diesel engines

3.10.1 The following components are to be inspected and checked in the dismantled condition, where deemed necessary by the Surveyor:

- cylinders, cylinder covers, pistons, piston rods and bolts, cross heads, crankshaft and all bearings
- camshaft, with drive and bearings
- tie rods, frame, foundation and fastening elements
- injection system, attached pumps and compressors, superchargers, suction and exhaust lines, charging air coolers, filters, monitoring, control, protective and safety devices, starting, reversing and manoeuvring equipment.

Class renewal survey of diesel engines can be made during the main overhaul, subject to the presence of the Surveyor.

Note 1: In case of medium speed diesel engines, dismantling and replacement of main and crank bearings may be postponed until the service life limits have been reached.

A reduction in the scope of survey may be agreed to upon examination of the maintenance protocols.

3.11 Auxiliary machinery, equipment and piping, survey performance

3.11.1 The following components are to be inspected and tested in dismantled condition, where deemed necessary by the Surveyor:

- all pumps of the essential systems
- air compressors, including safety devices
- separators, filters and valves
- coolers, pre-heaters
- piping, pipe connections, compensators and hoses
- emergency drain valves and bilge piping systems
- tank filling level indicators
- installations preventing the ingress of water into open spaces
- freshwater distillation plant, where provided
- oil purifier and sewage systems
- additional systems and components, where deemed necessary by the Surveyor, as well as special equipment and installations if included in the scope of classification.

3.12 Electrical installations

3.12.1 On main and emergency switchboards, after cleaning when necessary, feeder circuit breakers being open, busbar circuit closed, measuring and monitoring instruments disconnected, the resistance of insulation measured across each insulated busbar and hull, and across insulated busbars is not to be less than 1 MΩ.

3.12.2 For generators, the equipment and circuits normally connected between the generator and first circuit breaker being connected, preferably at working temperature whenever possible, the resistance of insulation, in ohms, is to be more than 1000 times the rated voltage, in volts. The insulation resistance of generators separate exciter gear is not to be less than 250000 Ω.

3.12.3 With all circuit breakers and protective devices closed, except for the generators, the insulation resistance of the entire electrical system is to be checked.

In general, the resistance is not to be less than 100 000 Ω. However, the variation of the resistance with time is to be checked, comparing the current figure with previous readings. If insulation resistance drops suddenly or is insufficient, the defective circuits are to be traced by disconnecting the circuits as necessary.

3.12.4 These measurements are subject to a report to be submitted to the Surveyor. In case the results are not satisfactory, supplementary investigation and necessary repairs have to be carried out to the Surveyor's satisfaction.

3.12.5 The proper operation of the remote stopping systems of:

- transfer and fuel oil pumps
- forced draught fans and engine room ventilation fans,

are to be verified.

3.13 Automated installations

3.13.1 The class renewal survey of classed automated installations consists of:

- a general examination of the control systems and random check of the proper operation of the main measuring, monitoring, alarm and automatic shut-off systems
- the checking of the fire detectors and bilge flooding alarms
- the checking of a number of other alarm channels selected at random, according to a complementary program of examinations, tests and checks prepared in agreement with the Owner and based upon operating conditions of the unit and experience of the previous surveys.

These checks are to carried out in normal operation, when practicable, or by simulation.

3.14 Pipes in tanks

3.14.1 Where pipes are led through tanks, they are to be examined and, if required by the Surveyor, subjected to hydraulic tests, when, for the respective tanks, an internal examination is required. Depending on the results obtained, thickness measurements may be required.

3.15 Fire-extinguishing and fire alarm systems

3.15.1 General requirements

Proof is to be furnished to the Surveyor that the entire fire-extinguishing equipment is ready for operation and in a satisfactory condition.

On the occasion of every class renewal survey, the installation is to be subjected to a visual inspection and test, if deemed necessary by the Surveyor.

Equipment (cylinders, bottles, fire extinguishers, etc.) is to be inspected, according to the manufacturer's instructions or applicable codes, by an approved or recognized company. Reports of these inspections are to be provided to the Surveyor.

Emergency exits/escapes are to be inspected.

3.16 Trials

3.16.1 Upon completion of the surveys for class renewal, the Surveyor is to be satisfied that the machinery installation, including electrical installations, as well as special equipment and installations are operable without restrictions. In case of doubt, trials and/or operational tests may be necessary.

3.17 Stability

3.17.1 Where significant modifications have been made to the vessel, a lightweight survey is to be carried out to verify any changes in lightship displacement and in the longitudinal position of the centre of gravity. Where, in comparison with the approved stability information, a deviation exceeding 2% in the lightship displacement or a deviation of the longitudinal centre of gravity exceeding 1% of the rule length is found or anticipated, the unit is to be submitted to a new inclining test.

SECTION 2 SURVEYS FOR MAINTENANCE OF CLASS - ADDITIONAL REQUIREMENTS

1 General

1.1 Application

1.1.1 The purpose of this Section is to give details on the scope of surveys of specific equipment and systems fitted on board the unit, which are covered by an additional class notation. Unless otherwise specified in Ch 1, Sec 2, [1.8], the scope of these surveys provides the requirements to be complied with for the maintenance of the relevant additional class notation.

1.1.2 These specific requirements are additional to those laid down in Ch 3, Sec 1. These surveys are to be carried out at intervals as described in Ch 2, Sec 2, [1.5], as far as possible concurrently with the surveys of the same type, i.e. quarter term, intermediate or class renewal surveys.

1.1.3 The equipment and systems are also to be submitted to occasional survey whenever one of the cases indicated in Ch 2, Sec 2, [1.6] occurs.

1.1.4 For the assignment of the additional class notations, units are to be submitted to an admission to class survey as described in Ch 2, Sec 4, [1.1] and Ch 2, Sec 4, [1.2] for new and existing installations, respectively, as applicable.

Table 1 : Additional class notations for which specific survey requirements are applicable

Additional class notation	Ref. in this Section	Type of surveys affected by these specific requirements
Comfort on board: **FE-COMF(N-V)**	[2]	• intermediate • class renewal
Green passport for unit recycling: **Green passport**	[3]	class renewal
Operation in ice environment: **FE-Ice(20)** **FE-Ice(30)** **FE-Ice(40)**	[4]	class renewal
Pollution prevention: **Clean-unit** **AWT** **GWT** **NDO-x days** **NOX-x%** **OWS-x ppm** **SOX-x%**	[5]	• intermediate • class renewal

1.2 Additional class notations subject to additional surveys

1.2.1 The specific requirements detailed in this Section are linked to the additional class notation(s) assigned to the unit. Where a unit has more than one additional class notation, the specific requirements linked to each additional class notation are applicable as long as they are not contradictory.

1.2.2 Tab 1 indicates which additional class notations are subject to specific requirements, and in which Article they are specified.

2 Comfort on board

2.1 General

2.1.1 The requirements of this Article apply to units which have been assigned the additional class notation **FE-COM(N-V)** as described in Ch 1, Sec 2, [1.8.2].

2.1.2 The Owner is to inform the Society in order to submit the unit to a survey so as to maintain the additional class notation after modifications, alterations or repairs which could affect the noise and vibration environment have occurred.

2.2 Intermediate survey

2.2.1 The Owner or his representative is to declare to the attending Surveyor that no significant modifications have been made without the prior approval of the Society, in particular with respect to:

- modifications/repairs carried out in staff or public spaces
- machinery modifications, main repairs
- list of any alterations, repairs or damages.

2.3 Class renewal survey

2.3.1 The general wear of the unit can induce vibration and noise increase. A survey including noise measurements in service conditions, insulation and impact noise measurements is to be carried out.

Measurements may be limited to 30% of the initial survey measuring points.

3 Green passport for unit recycling

3.1 General

3.1.1 Application

The requirements of this Article apply to units which have been assigned the additional class notation **Green passport** related to unit recycling, as described in Ch 1, Sec 2, [1.8.5].

3.2 Class renewal survey

3.2.1 The class renewal survey is to be carried out in compliance with the requirements of NR528 Green Passport.

4 Operation in ice environment

4.1 General

4.1.1 The requirements of this Article apply to units which have been assigned one of the following additional class notations as described in Ch 1, Sec 2, [1.8.6]:

- **FE-Ice(20)**
- **FE-Ice(30)**
- **FE-Ice(40)**

4.2 Class renewal survey

4.2.1 Thickness measurements

Additional systematic thickness measurements are required in the areas where strengthening for operation in an ice environment has been applied in accordance with the requirements in Pt D, Ch 2, Sec 4, [2], as per Tab 2.

Table 2 : Scope of survey for operation in ice

Unit age, in years, at time of class renewal survey		
age ≤ 10	10 < age ≤ 20	20 < age
	selected plates	all plates
		selected internal frames, stiffeners and stringers

4.2.2 River chests

During the bottom survey in dry condition which is to be carried out concurrently with the class renewal survey (see Ch 3, Sec 1, [3.2]), the specific arrangements related to river chests protected against ice blocking, such as heating coil and cooling water discharge piping, are to be checked.

5 Pollution prevention

5.1 General

5.1.1 Application

The requirements of this Article apply to units which have been assigned one of the following additional class notations related to pollution prevention systems, as described in Ch 1, Sec 2, [1.8.7]:

- **Clean-unit**
- **AWT**
- **GWT**
- **NDO-x days**
- **NOX-x%**
- **OWS-x ppm**
- **SOX-x%**

5.2 Prevention of water pollution

5.2.1 First survey

a) Confirmation of no discharge period

During the first survey, the Surveyor collects the results of tests and measurements undertaken by the Owner according to Pt D, Ch 2, Sec 5, [11]. These results are used to confirm or modify the no discharge numeral appended to the notations **NDO-x days**.

b) Audit

An on board audit of the procedures, as required in Pt D, Ch 2, Sec 5, is done by the Surveyor in order to ascertain that the staff are familiar with the unit's on board procedures for preventing pollution and in order to check that the discharge records mentioned in Pt D, Ch 2, Sec 5 are properly completed.

5.2.2 Intermediate survey

a) General

The survey is to include, as far as practicable:

- confirmation of the installation being in accordance with the plans. If modifications have been made, checking that these modifications are in accordance with the approved documentation (for all the additional class notations related to pollution prevention systems)
- general examination of the most important components of the sewage treatment plant, the garbage treatment plant, the oil filtering equipment, the incinerators if fitted, the comminuters and grinders, the hazardous wastes recovery unit if fitted (for **Clean-unit** and **NDO-x days**)
- general examination of the holding tanks, including examination of a possible corrosion protection of the inside surfaces of the tanks which are to be in good condition (for **Clean-unit)**
- verification of the satisfactory condition of the standard discharge connections for oil and wastewater (for **Clean-unit** and **AWT**)
- external examination and operating tests of the equipment and systems as required in Pt D, Ch 2, Sec 5 (for all the additional class notations related to pollution prevention systems)
- confirmation that the hazardous wastes are properly stowed as specified in the garbage management plan (for **Clean-unit** and **NDO-x days**).

For some pollution prevention system of [5.1.1], the survey is also to include, as far as practicable:

- ascertainment of the correct concentration of the disinfectant in the effluent (for **Clean-unit**, **AWT** and **GWT**)
- ascertainment of possible concentration of other chemicals in the effluent (for **Clean-unit**, **AWT** and **GWT**).

b) Review of records

The following records for the preceding 12 months are to be reviewed as necessary:

- oil record book (for **Clean-unit** and **OWS-x ppm**)
- garbage record book (for **Clean-unit** and **OWS-x ppm**)
- sewage and grey water discharge book (for **Clean-unit**, **GWT** and **AWT**)
- emissions record (for **NOX-x%** and **SOX-x%**)
- results of the tests on effluents done by the Owner according to Pt D, Ch 2, Sec 5, [11.2.3] for any pollution prevention system of [5.1.1] (for **AWT**).

5.2.3 Class renewal survey

The requirements given in [5.2.2] are to be complied with. In addition, for all the additional class notations related to pollution prevention systems, the following is to be carried out:

- demonstration, under working conditions, of the correct functions of the most important components of the sewage treatment plant or AWT plant if fitted, the garbage treatment plant, the oil filtering equipment, the incinerators if fitted, the comminuters and grinders, the hazardous waste recovery unit if fitted
- ascertainment of the correct function of the alarms.

5.3 Prevention of air pollution

5.3.1 Intermediate survey

a) Ozone depleting substances (**Clean-unit**)

A procedure for verification of the system and equipment condition by an authorised organisation is to be settled, at each **p**/2. The interval of this verification may be extended in the case of predictive maintenance scheme approved by the Society.

A procedure for weekly verification and maintenance is to be settled enabling to:

- check the tightness of the circuits by satisfactory means (such as weighing or vessel pressure monitoring)
- identify the location of possible leakage
- carry out necessary corrective actions.

Record books tracing all the operations carried out on board the unit are to be kept on board and updated after each intervention. They are to include, in particular, the following records:

- presence of leak and corrective action
- volume of substance recovered and indication of the storage location
- volume of substance recharged
- volume of substance consumed
- volume of substance disposed.

The survey is to include the following items:

- verification that the above procedures for annual and weekly checking of systems with ozone depleting substances are available on board
- confirmation that appropriate entries are being made in the record book for ozone depleting substances
- test of the proper operation of the leak detectors and related audible and visual alarms
- review of ozone depleting substance record book.

b) NO_X emission (**NOX-x%**)

- during the quarter term survey, it is to be confirmed that the NO_X emission control procedure is available on board
- NO_X emission records.

c) SO_X emission (**Clean-unit**, **SOX-x%**)

Procedures are to be established to detail the maximum sulphur content in the fuel oil purchase orders, and to check the actual content of sulphur at the delivery of bunker.

In the case the actual sulphur content is checked by sampling testing and analysis, procedures are to be carried out in accordance with a recognised standard acceptable to the Society.

The fuel management procedures are to be established and followed as part of the certified ship management system of the unit.

Records on purchase orders and on type of checking carried out, including results, are to be kept on board.

The survey is to include the following items:

- verification that the above procedures for defining, ordering and checking fuel oils for control of SO_X emission are available on board
- confirmation that fuel oil sulphur content records are available on board
- emission record (when exhaust gas cleaning is provided (EGC)).

d) On board incinerator (**Clean-unit**)

The survey is to include the following items, when fitted:

- external examination of the incinerators and confirmation that such equipment operates satisfactorily
- test of the alarms, exhaust monitoring devices and emergency stop located outside the compartment.

5.3.2 Class renewal survey

The requirements given in [5.3.1] are to be complied with. In addition, the following is to be carried out:

- confirmation of the operation and calibration of the emissions analysers if fitted (for **NOX-x%** and **SOX-x%**)
- external examination and operating tests of the equipment and systems, as required in Pt D, Ch 2, Sec 5 (for all the additional class notations related to pollution prevention systems).

RULES FOR THE CLASSIFICATION OF FLOATING ESTABLISHMENTS

Part B
Hull and Stability

Chapters **1 2 3 4 5 6 7 8**

September 2012

Part B
Hull and Stability

Chapter 1
GENERAL

SECTION 1 APPLICATION

Symbols

L : Rule length, in m, defined in Ch 1, Sec 2, [1.1]

B : Breadth, in m, defined in Ch 1, Sec 2, [1.2]

D : Depth, in m, defined in Ch 1, Sec 2, [1.3]

T : Draught, in m, defined in Ch 1, Sec 2, [1.4]

L_{OA} : Length overall, in m, defined in Ch 1, Sec 2, [1.5]

L_{WL} : Length of waterline, in m, defined in Ch 1, Sec 2, [1.6]

Δ : Displacement, in tons, at draught T

C_B : Block coefficient:

$$C_B = \frac{\Delta}{L \cdot B \cdot T}$$

1 General

1.1 Structural requirements

1.1.1 This Chapter contains the requirements for the determination of the minimum hull scantlings, applicable to all floating establishments, up to 135 m in length, made in welded steel or aluminium alloy.

1.1.2 Units with length exceeding 135 m, units whose hull materials are different from those mentioned in [1.1.1] and units with novel features or unusual hull design are to be individually considered by the Society, on the basis of the principles and criteria adopted in this Rule Note.

1.1.3 The unit's structure is to be checked by the designer to make sure that it withstands the loads resulting from the towing.

1.1.4 The strength of the units constructed and maintained according to this Rule Note is sufficient for the scantling draught considered when applying the Rules.

1.2 Limits of application to lifting appliances

1.2.1 The fixed parts of lifting appliances, considered as an integral part of the hull, are the structures permanently connected by welding to the hull (for instance crane pedestals, masts, king posts, derrick heel seatings, etc., excluding cranes, derrick booms, ropes, rigging accessories, and, generally, any dismountable parts). The shrouds of masts embedded in the unit's structure are considered as fixed parts.

1.2.2 The fixed parts of lifting appliances and their connections to the unit's structure are covered by the Rules, even when the certification of lifting appliances is not required.

2 Rule application

2.1 Unit parts

2.1.1 General

For the purpose of application of this Rule Note, the unit is considered as divided into the following parts:

- central part
- end parts.

2.1.2 Central part

The central part includes the structures within the region extending over 0,5 L through the midship section.

2.1.3 End parts

The end parts include the structures of the peaks and those located in the part extending over 0,1 L beyond the end bulkheads.

3 Rounding off of scantlings

3.1 Plate thicknesses

3.1.1 The rounding off of plate thicknesses is to be obtained from the following procedure:

a) the net thickness (see Ch 2, Sec 4, [2]) is calculated in accordance with the rule requirements

b) corrosion addition t_C (see Ch 2, Sec 4, [3]) is added to the calculated net thickness, and the gross thickness obtained is rounded off to the nearest half-millimetre

c) the rounded net thickness is taken equal to the rounded gross thickness obtained in b), minus the corrosion addition t_C.

3.2 Stiffener section moduli

3.2.1 Stiffener section moduli as calculated in accordance with the rule requirements are to be rounded off to the nearest standard values; however, no reduction may exceed 3%.

SECTION 2 DEFINITIONS

1 General

1.1 Rule length

1.1.1 The rule length L is the distance, in m, taken equal to the length of the load waterline.

For units with unusual end arrangements, the rule length L is to be considered on a case-by-case basis.

1.2 Breadth

1.2.1 The breadth B is the greatest moulded breadth, in m, measured amidships below the weather deck.

1.3 Depth

1.3.1 The depth D is the distance, in m, measured vertically at the midship transverse section, from the moulded base line to the top of the deck beam at side on the uppermost continuous deck.

In the case of a unit with a solid bar keel, the moulded base line is to be taken at the intersection between the upper face of the bottom plating and the solid bar keel.

1.4 Draught

1.4.1 The draught T is the distance, in m, measured vertically at the midship transverse section, from the moulded base line to the load line.

In the case of units with a solid bar keel, the moulded base line is to be taken as defined in [1.3].

1.5 Length overall

1.5.1 The length overall is the extreme length of the unit, in m.

1.6 Length of waterline

1.6.1 The length of waterline is the length of the hull, in m, measured at the maximum draught.

1.7 Superstructure

1.7.1 A superstructure is a decked structure connected to the strength deck defined in [1.8], extending from side to side of the unit or with the side plating not being inboard of the shell plating more than 0,04 B.

1.8 Strength deck

1.8.1 The strength deck (main deck) is the uppermost continuous deck contributing to the hull girder longitudinal strength.

1.9 Weather deck

1.9.1 The weather deck is the uppermost continuous exposed deck.

1.10 Bulkhead deck

1.10.1 The bulkhead deck is the uppermost deck up to which the transverse watertight bulkheads and the shell are carried.

1.11 Evacuation deck

1.11.1 The evacuation deck is the deck giving access to / exit from a floating establishment. This deck is connected to shore by means of ramps or footbridges so designed that the slope may not exceed 10% (see Fig 1).

1.12 Distance H

1.12.1 The Distance H is the distance of the farthest deck accessible to public to evacuation deck (see Fig 1).

H : $H = \max(H_1, H_2)$

H_1 : Height of the farthest deck accessible to public above evacuation deck

H_2 : Height of evacuation deck above the farthest deck accessible to public (below evacuation deck).

1.13 Cofferdam

1.13.1 A cofferdam means an empty space arranged so that compartments on each side have no common boundary; a cofferdam may be located vertically or horizontally. As a rule, a cofferdam is to be properly ventilated and of a sufficient size to allow for inspection.

1.14 Weathertight

1.14.1 "Weathertight" is the term used to a closure or a structure which prevents water from penetrating into the unit under any service conditions. Weathertight designates structural elements or devices which are so designed that the penetration of water inside the unit is prevented:

- for one minute when they are subjected to a pressure corresponding to a 1 m head of water, or
- for ten minutes when they are exposed to the action of a jet of water with a minimum pressure of 1 bar in all directions over their entire area.

Following constructions are regarded as weathertight:

- weathertight doors complying with ISO 6042
- ventilation flaps complying with ISO 5778
- airpipe heads of automatic type and of approved design.

Weathertightness is to be proven by hose tests or equivalent tests accepted by the Society before installing.

1.15 Watertight

1.15.1 "Watertight" designates structural elements or devices which meet all the conditions stated for weathertightness and also remain tight at the anticipated internal and external pressures.

Watertightness is to be proven by workshop testing and, where applicable, by type approvals in combination with construction drawings (e.g. watertight sliding doors, cable penetrations through watertight bulkheads).

2 Reference co-ordinates

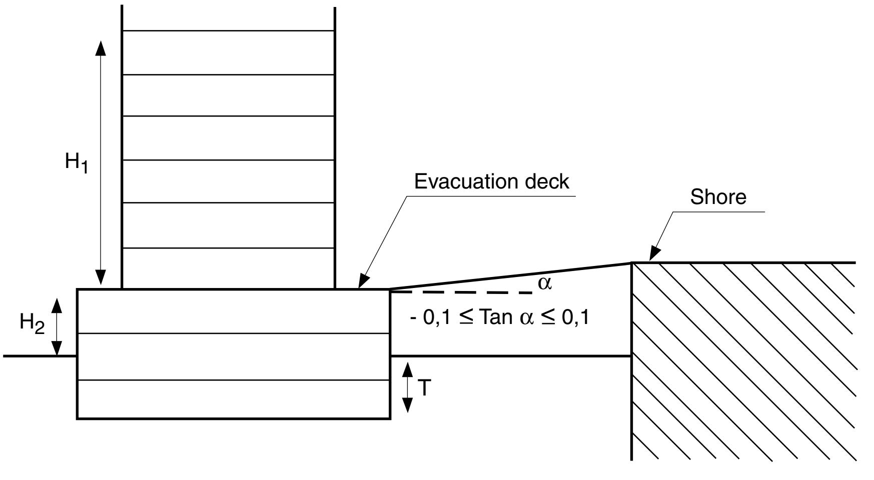
2.1

2.1.1 The unit's geometry, motions, accelerations and loads are defined with respect to the following right-hand co-ordinate system:

- Origin: intersection point of the longitudinal plane of symmetry of the unit, one end of L and the baseline
- X-axis: longitudinal axis, positive towards the other end
- Y-axis: transverse axis, positive towards portside
- Z-axis: vertical axis, positive upwards.

2.1.2 Positive rotations are oriented in anti-clockwise direction about the X-, Y- and Z- axes. T

Figure 1 : Evacuation deck and distance H



SECTION 3 DOCUMENTATION TO BE SUBMITTED

1 Documentation to be submitted for all units

1.1 Units surveyed by the Society during the construction

1.1.1 The plans and documents to be submitted to the Society for review/approval are listed in Tab 1.

Structural plans are to show details of connections of the various parts and, in general, are to specify the materials used, including their manufacturing processes, welding procedures and heat treatments.

Furthermore, considered values of corrosion margin are to be provided for structural design of increased corrosion addition with respect to rule minimum values.

1.1.2 The Society reserves the right to ask for further documents and drawings considered necessary.

Irrespective of this, the Rules of construction also apply to components and details not shown in the submitted drawings.

1.1.3 Any deviation from reviewed/approved drawings is subject to the Society's approval before the work is commenced.

1.1.4 The application of the Society's construction Rules does not exclude any patent claims.

1.1.5 Plans and documents to be submitted for information

In addition to those in [1.1.1], the following plans and documents are to be submitted to the Society for information:

- general arrangement
- capacity plan, indicating the volume and position of the centre of gravity of all compartments and tanks
- lines plan
- hydrostatic curves
- lightweight distribution.

In addition, when direct calculation analyses are carried out by the Designer according to the Rules requirements, they are to be submitted to the Society.

Table 1 : Plans and documents to be submitted for review / approval - All units

Plan or document	Containing also information on
Midship section Transverse sections Longitudinal sections Shell expansion Decks and profiles Double bottom Pillar arrangements Framing plan Welding table	Class characteristics Main dimensions Maximum draught Block coefficient for the length between perpendiculars at the maximum draught Frame spacing Setting pressure of safety relief valves, if any Design loads on decks Steel grades Location and height of air vent outlets of the various compartments Corrosion protection Openings in decks and shell and relevant compensations Boundaries of flat areas in bottom and sides Details of structural reinforcements and/or discontinuities Details related to welding
Watertight subdivision bulkheads	Openings and their closing appliances, if any
End parts' structure	Location and height of air vent outlets of the various compartments
Machinery space structures	Mass and centre of gravity of machinery and boilers, if any Mass of liquids contained in the machinery space
Superstructures	Extension and mechanical properties of the aluminium alloy used (where applicable)
Hatch covers, if any	Design loads on hatch covers Sealing and securing arrangements, type and position of locking bolts Distance of hatch covers from the load waterline and from the fore end
Movable decks and ramps, if any	
Windows and side scuttles, arrangements and details	

Plan or document	Containing also information on
Scuppers and sanitary discharges	
Bulwarks and freeing ports	Arrangement and dimensions of bulwarks on the main deck and superstructure deck
Plan of outer doors and hatchways	
Plan of manholes	
Plan of access to and escape from spaces	
Plan of ventilation	Use of spaces
Plan of watertight doors and scheme of relevant manoeuvring devices	Manoeuvring devices Electrical diagrams of power control and position indication circuits

Part B
Hull and Stability

Chapter 2
HULL AND STABILITY PRINCIPLES

SECTION 1 GENERAL ARRANGEMENT DESIGN

1 Subdivision arrangement

1.1 Number of watertight bulkheads

1.1.1 All units are to have at least the following transverse watertight bulkheads:

- two end bulkheads
- two bulkheads forming the boundaries of the machinery space.

1.1.2 Additional bulkheads

Additional bulkheads may be required:

- to comply with damage stability criteria
- to ensure sufficient transverse strength of the unit.

1.2 Height of transverse watertight bulkheads

1.2.1 Transverse watertight bulkheads are to extend up to the bulkhead deck.

1.2.2 Where it is not practicable to arrange a watertight bulkhead in one plane, a stepped bulkhead may be fitted. In this case, the part of the deck forming the step is to be watertight and equivalent in strength to the bulkhead.

1.3 Openings in watertight bulkheads

1.3.1 Certain openings below the bulkhead deck are permitted in bulkheads other than the end bulkheads, but these are to be:

- kept to a minimum compatible with the design and proper working of the unit, and
- provided with watertight doors having strength such as to withstand the head of water to which they may be subjected.

1.4 Watertight doors

1.4.1 Doors cut out in watertight bulkheads are to be fitted with watertight closing appliances. The arrangements to be made concerning these appliances are to be approved by the Society.

1.4.2 Thickness of the watertight doors is to be not less than that of the adjacent bulkhead plating, taking account of their actual framing spacing.

1.4.3 Where vertical stiffeners are cut in way of watertight doors, reinforced stiffeners are to be fitted on each side of the door and suitably overlapped; cross-bars are to be provided to support the interrupted stiffeners.

2 Compartment arrangement

2.1 Cofferdams

2.1.1 Cofferdams are to be provided between compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and those intended for fresh water (drinking water, water for boilers) as well as tanks intended for the carriage of liquid foam for fire-extinguishing.

2.1.2 Cofferdams separating fuel oil tanks from lubricating oil tanks and the latter from those intended for the storage of liquid foam for fire-extinguishing or fresh water or boiler feed water may not be required when deemed impracticable or unreasonable by the Society in relation to the characteristics and dimensions of the spaces containing such tanks, provided that:

- the thickness of common boundary plates of adjacent tanks is increased, with respect to the rule thickness, by:
  - 2 mm in case of tanks carrying fresh water or boiler feed water, and
  - 1 mm in all the other cases
- the sum of the throats of the weld fillets at the edges of these plates is not less than the thickness of the plates themselves
- the structural test is carried out with a head increased by 1,0 m with respect to Ch 3, Sec 3, [3].

2.1.3 Spaces intended for the storage of flammable liquids are to be separated from accommodation/public and service spaces by means of a cofferdam. Where accommodation/public and service spaces are arranged immediately above such spaces, the cofferdam may be omitted only where the deck is not provided with access openings and is coated with a layer of material recognized as suitable by the Society.

The cofferdams may also be omitted where such spaces are adjacent to a passageway, subject to the conditions stated in [2.1.2] for fuel oil or lubricating oil tanks.

2.1.4 Where a corner to corner situation occurs, tanks are not considered to be adjacent.

Adjacent tanks not separated by cofferdams are to have adequate dimensions to ensure easy inspection.

3 Access arrangement

3.1 Double bottom

3.1.1 Inner bottom manholes

Inner bottom manholes are to be not less than 0,40 m x 0,40 m. Their number and location are to be so arranged as to provide convenient access to any part of the double bottom.

Inner bottom manholes are to be closed by watertight plate covers.

Doubling plates are to be fitted on the covers, where secured by bolts.

Where no ceiling is fitted, covers are to be adequately protected from damage.

3.1.2 Floor and girder manholes

Manholes are to be provided in floors and girders so as to provide convenient access to all parts of the double bottom.

The size of manholes and lightening holes in floors and girders is, in general, to be less than 50 per cent of the local height of the double bottom.

Where manholes of greater sizes are needed, edge reinforcement by means of flat bar rings or other suitable stiffeners may be required.

Manholes may not be cut in the continuous centreline girder or in floors and girders below pillars, except where allowed by the Society, on a case-by-case basis.

3.2 Access to side tanks

3.2.1 Where openings allowing access to side tanks are cut in the stringer plate, they are to be arranged clear of the hatch corners and to be of even-deck design, without obstacles causing stumbling. In order to assure the continuity of the strength, they are to be cut smooth along a well rounded design and are to be strengthened by thick plates, by doubling plates or by other equivalent structure.

SECTION 2 STABILITY

Symbols

L : Rule length, in m, defined in Ch 1, Sec 2, [1.1]

B : Breadth, in m, defined in Ch 1, Sec 2, [1.2]

D : Depth, in m, defined in Ch 1, Sec 2, [1.3]

T : Draught, in m, defined in Ch 1, Sec 2, [1.4]

L_{WL} : Length of waterline, in m, defined in Ch 1, Sec 2, [1.6]

Δ : Displacement, in tons, at draught T

C_B : Block coefficient, defined in Ch 1, Sec 1

KG : Height, in m, of the centre of gravity above base line.

1 General

1.1 Application

1.1.1 This Section provides requirements allowing to ascertain that the unit has adequate intact stability under specified service conditions.

1.1.2 Depending on the vessel traffic in the operating area of the unit and/or when the unit is accessible only via waterway by means of self-propelled vessels, proof of damage stability according to Pt D, Ch 2, Sec 2 may be required by the Society.

1.1.3 When the unit is also subject to statutory Rules, the Society reserves the right to accept these Regulations as a substitution to the present rule requirements.

1.2 Definitions

1.2.1 Plane of maximum draught

Plane of maximum draught is the water plane corresponding to the maximum draught at which the unit is authorised to operate.

1.2.2 Bulkhead deck

Bulkhead deck is defined in Ch 1, Sec 2, [1.10.1].

1.2.3 Freeboard

Freeboard 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 unit's side.

1.2.4 Residual freeboard

Residual freeboard is the vertical clearance available, in the event of the unit 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 unit's side shell.

1.2.5 Safety clearance

Safety clearance is the distance between the plane of maximum draught and the parallel plane passing through the lowest point above which the unit is no longer deemed to be watertight.

1.2.6 Residual safety clearance

Residual safety clearance is the vertical clearance available, in the event of the unit heeling over, between the water level and the lowest point of the immersed side, beyond which the unit is no longer regarded as watertight.

1.2.7 Weathertight

"Weathertight" is defined in Ch 1, Sec 2, [1.14.1].

1.2.8 Watertight

"Watertight" is defined in Ch 1, Sec 2, [1.15.1].

1.2.9 Lightship

The lightship is a unit complete in all respects, but without consumables, stores, public, staff and effects, and without liquids on board except for machinery and piping fluids, such as lubricants and hydraulics, which are at operating levels.

1.2.10 Inclining test

The inclining test is a procedure which involves moving a series of known weights, normally in the transverse direction, and then measuring the resulting change in the equilibrium heel angle of the unit. By using this information and applying basic naval architecture principles, the unit's vertical centre of gravity (VCG or KG) is determined.

1.2.11 Lightweight check

The lightweight check is a procedure which involves auditing all items which are to be added, deducted or relocated on the unit at the time of the inclining test so that the observed condition of the unit can be adjusted to the lightship condition. The weight and longitudinal, transverse and vertical locations of each item are to be accurately determined and recorded. The lightship displacement and longitudinal centre of gravity (LCG) can be obtained using this information, as well as the static waterline of the unit at the time of the inclining test as determined by verifying draught marks of the unit, the unit's hydrostatic data and the water density.

2 Examination procedure

2.1 Documents to be submitted

2.1.1 List of information

The following information is to be included in the documents to be submitted:

- general description of the unit
- lines plan / hull definition such as offset table
- general arrangement and capacity plans indicating the assigned use of the compartments and spaces (public, stores, accommodation, etc.)
- hydrostatic curves
- cross curves or tables of stability calculated on a free trimming basis, for the ranges of displacement and trim anticipated in normal operating conditions, with indication of the volumes which have been considered buoyant
- tank sounding tables or curves showing capacities, centres of gravity, and free surface data for each tank
- lightship data from the inclining test, including lightship displacement, centre of gravity co-ordinates, place and date of the inclining test, as well as the Society approval details specified in the inclining test report. It is suggested that a copy of the approved test report be included.

  Where the above-mentioned information is derived from a sister unit, the reference to this sister unit is to be clearly indicated, and a copy of the approved inclining test report relevant to this sister unit is to be included
- standard loading conditions and examples for developing other acceptable loading conditions using the information contained in the stability booklet
- intact stability results (total displacement and its centre of gravity co-ordinates, draughts at perpendiculars, GM, GM corrected for free surfaces effect, GZ values and curve, criteria reporting a comparison between the actual and the required values) are to be available for each of the above-mentioned operating conditions
- information on loading restrictions (maximum allowable load on decks, maximum KG or minimum GM curve or table which can be used to determine compliance with the applicable intact and damage stability criteria) when applicable
- information about openings (location, tightness, means of closure), pipes or other progressive flooding sources
- information concerning the use of any special cross-flooding fittings with descriptions of damage conditions which may require cross-flooding, when applicable.

The Society may require any other necessary guidance for the safe operation of the unit.

2.2 Displacement and centre of gravity

2.2.1 The lightship displacement and the location of the centre of gravity are to be determined either by means of an inclining experiment (see [3]) or by detailed mass and moment calculation. In this latter case, the lightweight of the unit is to be checked by means of a lightweight test with a tolerance limit of about 5% between the mass determined by calculation and the displacement determined by the draught readings.

The weight and centre of gravity calculation is to be submitted before the lightweight survey is to be performed.

2.3 Effects of free surfaces of liquids in tanks

2.3.1 For all loading conditions, the initial metacentric height and the righting lever curve are to be corrected for the effects of free surfaces of liquids in tanks.

2.3.2 Free surface effects are to be considered for any filling level of the tank. Free surface effects need not be considered where a tank is nominally full.

3 Inclining test and lightweight check

3.1 General

3.1.1 Any unit for which a stability investigation is requested in order to comply with class requirements is to be initially subjected to an inclining test permitting the evaluation of the position of the lightship centre of gravity, or a lightweight check of the lightship displacement, so that the stability data can be determined. Cases for which the inclining test is required and those for which the lightweight check is accepted in its place are listed in [3.1.2].

The inclining test or the lightweight check is to be attended by a Surveyor of the Society. The Society may accept inclining tests or lightweight checks attended by a member of the flag Administration.

3.1.2 Inclining test

The inclining test is required in the following cases:

- for any new unit, after its completion, except in the cases specified in [3.1.3]
- for any unit, if deemed necessary by the Society, where any alterations are made so as to materially affect the stability.

3.1.3 Lightweight check

The Society may allow a lightweight check to be carried out in lieu of an inclining test in the case of:

- an individual unit, provided basic stability data are available from the inclining test of a sister unit and a lightweight check is performed in order to prove that the sister unit corresponds to the leader unit. In such case, the Society is satisfied when the result of the lightweight check shows a deviation from the displacement of the leader unit not greater than the values specified in Tab 1.

  The final stability data to be considered for the sister unit, in terms of displacement and position of the centre of gravity, are those of the leader unit.

- special types of unit, such as catamarans, broad pontoon-shaped units, provided that:
  - a detailed list of weights and the positions of their centres of gravity is submitted
  - a lightweight check is carried out, showing accordance between the estimated values and those determined
  - adequate stability is demonstrated in all the loading conditions.

Table 1 : Maximum deviation, in %

$L \leq 50$ m	$50\text{ m} < L \leq 135$ m
2	$2,455 - \frac{L}{110}$

3.2 Detailed procedure

3.2.1 General conditions of the unit

Prior to the test, the Society's Surveyor is to be satisfied of the following:

- the weather conditions are to be favourable
- the unit is to be moored in a quiet, sheltered area free from extraneous forces, such as to allow unrestricted heeling. The unit is to be positioned in order to minimise the effects of possible wind and stream
- the unit is to be transversely upright and hydrostatic data and sounding tables are to be available for the actual trim
- cranes and derrick capable of inducing oscillations are to be secured
- boilers, pipes and any other systems containing liquids are to be filled
- the bilge and the decks are to be thoroughly dried
- preferably, all tanks are to be empty and clean, or completely full. The number of tanks containing liquids is to be reduced to a minimum, taking into account the above-mentioned trim. The shape of the tank is to be such that the free surface effect can be accurately determined and remain almost constant during the test. All the cross connections are to be closed
- the weights necessary for the inclination are to be already on board, located in the correct place
- all work on board is suspended and personnel not directly involved in the inclining test is not to be on board
- the unit is to be as complete as possible at the time of the test. The number of weights to be removed, added or shifted is to be limited to a minimum. Temporary material, tool boxes, staging, sand, debris, etc., on board is to be reduced to an absolute minimum
- initial heeling angle is not to be greater than 0,5° prior to the start of the inclining test.

3.2.2 Inclining weights

The total weight used is preferably to be sufficient to provide a minimum inclination of one degree and a maximum of two degrees of heel to each side. The Society may, however, accept a smaller inclination angle for the large units, provided that the requirement on pendulum deflection or U-tube difference in height specified in [3.2.4] is complied with. Test weights are to be compact and of such a configuration that the VCG (vertical centre of gravity) of the weights can be accurately determined. Each weight is to be marked with an identification number and its weight. Re-certification of the test weights is to be carried out prior to the incline. A crane of sufficient capacity and reach, or some other means, is to be available during the inclining test to shift weights on the deck in an expeditious and safe manner. Water ballast is generally not acceptable as an inclining weight.

3.2.3 Water ballast as inclining weight

Where the use of solid weights to produce the inclining moment is demonstrated to be impracticable, the movement of ballast water may be permitted as an alternative method. This acceptance would be granted for a specific test only, and approval of the test procedure by the Society is required prior to the test. As a minimal prerequisite for acceptability, the following conditions are to be required:

- inclining tanks are to be wall-sided and free of large stringers or other internal structural members that create air pockets
- tanks are to be directly opposite to maintain the trim
- specific gravity of ballast water is to be measured and recorded
- pipelines to inclining tanks are to be full. If the piping layout is unsuitable for internal transfer, portable pumps and pipes/hoses may be used
- blanks are to be inserted in transverse manifolds to prevent the possibility of liquids leaking during transfer. Continuous valve control is to be maintained during the test
- all inclining tanks are to be manually sounded before and after each shift
- vertical, longitudinal and transverse centres are to be calculated for each movement
- accurate sounding/ullage tables are to be provided. The initial heel angle is to be established prior to the incline in order to produce accurate values for volumes and transverse and vertical centres of gravity for the inclining tanks at every angle of heel. The draught marks amidships (port and starboard) are to be used when establishing the initial heel angle
- verification of the quantity shifted may be achieved by a flowmeter or similar device
- the time to conduct the inclining is to be evaluated. If time requirements for transfer of liquids are considered too long, water may be unacceptable because of the possibility of changing environmental conditions over long periods of time.

3.2.4 Pendulums

The use of three pendulums is recommended but a minimum of two pendulums is to be used to allow identification of bad readings at each pendulum station. However, for units of a length equal to or less than 30 m, one pendulum only may be accepted. Each is to be located in an area protected from the wind. The pendulums are to be long enough to give a measured deflection, to each side from upright, of at least 10 cm. To ensure recordings from individual instruments, it is suggested that the pendulums are physically located as far apart as practical.

The use of an inclinometer or a U-tube is to be considered on a case-by-case basis. It is recommended that inclinometers or other measuring devices only be used in conjunction with at least one pendulum.

3.2.5 Means of communication

Efficient two-way communications are to be provided between the central control and the weight handlers and between the central control and each pendulum station. One person at a central control station is to have complete control over all personnel involved in the test.

3.2.6 Documentation

The person in charge of the inclining test is to have, available, a copy of the following plans at the time of the test:

- hydrostatic curves or hydrostatic data
- general arrangement plan of decks, holds, inner bottoms, etc.
- capacity plan showing capacities and vertical and longitudinal centres of gravity of tanks. When water ballast is used as inclining weights, the transverse and vertical centres of gravity for the applicable tanks, for each angle of inclination, are to be available
- tank sounding tables
- draught mark locations, and
- docking drawing with keel thickness and draught mark corrections (if available).

3.2.7 Determination of the displacement

The Society's Surveyor is to carry out all the operations necessary for the accurate evaluation of the unit displacement at the time of the inclining test, as listed below:

- draught mark readings are to be taken amidships and at ends, at starboard and port sides
- the mean draught (average of port and starboard readings) is to be calculated for each of the locations where draught readings are taken and plotted on the unit's lines drawing or outboard profile to ensure that all readings are consistent and together define the correct waterline. The resulting plot is to yield either a straight line or a waterline which is either hogged or sagged. If inconsistent readings are obtained, the freeboards/draughts are to be measured once again
- all double bottoms, as well as all tanks and compartments which can contain liquids, are to be checked, particular attention being paid to air pockets which may accumulate due to the trim and the position of air pipes. The provisions of [3.2.1] are also to be taken into account
- it is to be checked that the bilge is dry and an evaluation of the liquids remaining in the pipes, boilers, condenser, etc. (with the exception of liquids included in the lightship, which cannot be pumped) is to be carried out
- the entire unit is to be surveyed in order to identify all items which need to be added, removed or relocated to bring the unit to the lightship condition. Each item is to be clearly identified by its weight and location of its centre of gravity
- the possible solid permanent ballast is to be clearly identified and listed in the report.

3.2.8 The incline

The standard test generally employs eight distinct weight movements as shown in Fig 1.

The weights are to be transversely shifted, so as not to modify the trim and the vertical position of the centre of gravity.

After each weight shifting, the new position of the transverse centre of gravity of the weights is to be accurately determined.

After each weight movement, the shifting distance (centre to centre) is to be measured and the heeling moment calculated, multiplying the distance by the amount of weight moved. The tangent is calculated for each pendulum, dividing the deflection by the length of the pendulum. The resultant tangents are plotted on the graph as shown in Fig 2.

Figure 1 : Weight shift procedure

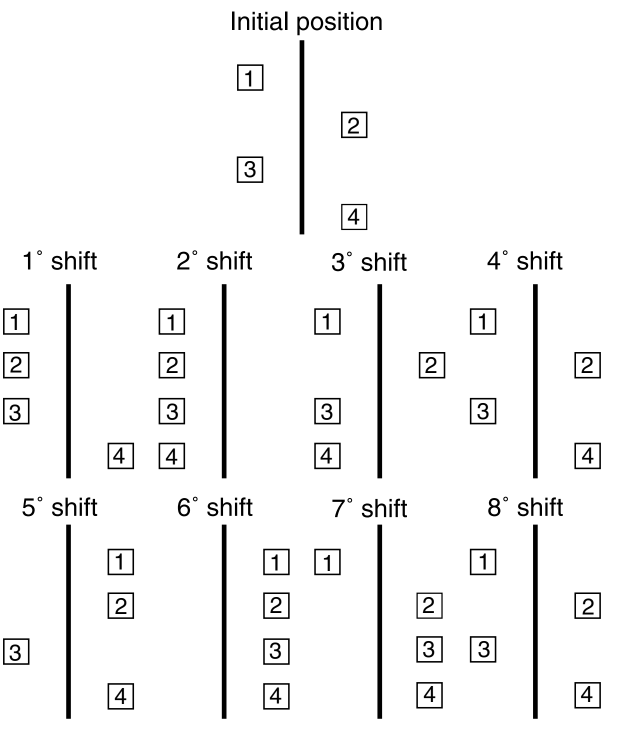
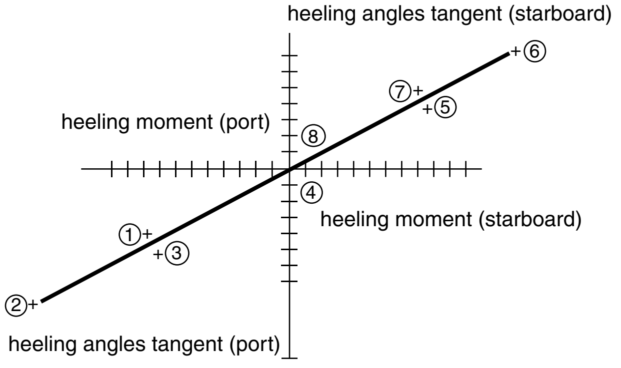


Figure 2 : Graph of resultant tangents



The pendulum deflection is to be read when the unit has reached a final position after each weight shifting.

During the reading, no movements of personnel are allowed.

For units with a length equal to or less than 30 m and pontoon-shaped units, four distinct weight movements may be accepted, subject to linearity of the graph of resultant tangents.

4 Buoyancy and stability

4.1 Intact stability

4.1.1 General

Proof of appropriate intact stability of the unit is to be furnished. All calculations are to be carried out free from trim and sinkage.

The lightship data taken into account for the stability calculation are to be determined by means of an inclining test.

4.1.2 Standard load conditions

The intact stability is to be proven for the following standard load conditions:

a) 100% public, 98% fuel and fresh water, 10% waste water

b) 100% public, 50% fuel and fresh water, 50% waste water

c) 100% public, 10% fuel and fresh water, 98% waste water

d) unladen unit: no public, 10% fuel and fresh water, no waste water.

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 operating, the requirement of [4.1.3], item d), is to be proven for the following load condition:

- 100% public, 50% fuel and fresh water, 50% waste water, all other liquid (including ballast) tanks being considered filled to 50%.

4.1.3 Intact stability criteria

The proof of adequate intact stability by means of a calculation is to be produced, using the following intact stability criteria, for the standard load conditions mentioned in [4.1.2], items a) to d):

a) the maximum righting lever arm h_{max} is to occur at a list angle of $\varphi_{max} \geq (\varphi_{mom} + 3°)$ and is not to be less than 0,20 m. However, in case $\varphi_f < \varphi_{max}$, the righting lever arm at the downflooding angle φ_f is not to be less than 0,20 m

b) the downflooding angle φ_f is not to be less than $\varphi_{mom} + 3°$

c) the area A under the curve of the righting lever arm is, depending on the position of φ_f and φ_{max}, to reach at least the values given in Tab 2, where:

φ	:	List angle
φ_f	:	List angle, at which openings in the hull, in the superstructure or deck houses which cannot be closed so as to be weathertight, submerge
φ_{max}	:	List angle at which the maximum righting lever arm occurs
φ_{mom}	:	Maximum list angle defined under item e)

d) the metacentric height at the start, GM_0, corrected by the effect of the free surfaces in liquid tanks, is not to be less than 0,15 m

e) in application of the heeling moment due to crowding of persons and wind pressure according to [4.1.4] and [4.1.5], the list angle φ_{mom} is not to be in excess of the value of 12°

f) for a heeling moment resulting from moments due to crowding of persons and wind pressure according to [4.1.4] and [4.1.5], the residual freeboard is to be not less than 200 mm

g) for units with windows 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 heeling moments resulting from item f).

Table 2 : Values of area A under the curve of righting lever arm

Case	Conditions	A, in m·rad
1	$\varphi_{max} \leq 15°$ or $\varphi_f \leq 15°$	0,05 up to MIN (φ_{max}, φ_f)
2	$15° < \varphi_{max} < 30°$ and $\varphi_{max} \leq \varphi_f$	0,035 + 0,001 (30 – φ_{max}) up to angle φ_{max}
3	$15° < \varphi_f < 30°$ and $\varphi_{max} > \varphi_f$	0,035 + 0,001 (30 – φ_f) up to angle φ_f
4	$\varphi_{max} \geq 30°$ and $\varphi_f \geq 30°$	0,035 to angle $\varphi = 30°$

4.1.4 Moment due to crowding of persons

The heeling moment M_P, in kN·m, due to one-sided accumulation of persons is to be calculated according to the following formula:

$$M_P = 9,81 Py = 9,81 \sum P_i y_i$$

where:

- P : Total weight of persons on board, in t, calculated by adding up the maximum permitted number of public and the maximum number of staff under normal operating conditions, assuming an average weight per person of 0,075 t
- y : Lateral distance, in m, of centre of gravity of total weight of persons P from the centre line
- P_i : Weight of persons accumulated on area A_i, in t:

  $P_i = 0,075\ n_i\ A_i$

  where:

  - A_i : Area, in m², occupied by persons
  - n_i : Number of persons per square meter:
    - for free deck areas and deck areas with movable furniture: $n_i = 3,75$
    - for deck areas with fixed seating furniture such as benches, n_i is to be calculated assuming an area of 0,50 m in width and 0,75 m in seat depth per person
- y_i : Lateral distance, in m, of geometrical centre of area A_i from centre line.

The calculation is to be carried out for an accumulation of persons both at starboard and at port.

The distribution of persons is to correspond to the most unfavorable one from the point of view of stability. Bedrooms are to be assumed unoccupied for the calculation of the person moment.

For the calculation of the loading cases, the centre of gravity of a person should be taken as 1 m above the lowest point of the deck at 1/2 L_{WL}, ignoring any deck curvature and assuming a weight 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:

- $y = B / 2$
- $P = 1,1 \cdot n_{max} \cdot 0,075$ for units without accommodations

  $P = 1,5 \cdot n_{max} \cdot 0,075$ for units with accommodations

with:

- n_{max} : Maximum permitted number of persons.

4.1.5 Moment due to lateral wind pressure

The moment M_W, in kN·m, due to lateral wind pressure is to be determined by the following formula:

$$M_W = 0,25\ A_W\ (z_W - z_r)$$

where:

- A_W : Lateral area above water, in m²
- z_W : Z-co-ordinate, in m, of the centre of gravity of area A_W
- z_r : Z-co-ordinate, in m, of the reaction point to be determined as follows:
  - for anchored units: $z_r = T/2$
  - for moored units: z_r is the height above baseline, in m, of the anchoring point on the unit.

4.2 Safety clearance and freeboard

4.2.1 General

The requirements of this sub-article do not apply to units of **Cat 5**.

4.2.2 Safety clearance

The safety clearance is to be at least equal to the sum of:

a) the additional lateral immersion which, measured on the outside plating, is produced by the permissible angle of heel according to [4.1.3], item e), and

b) the residual safety clearance according to [4.1.3], item g).

For units without a bulkhead deck, the safety clearance is to be at least 500 mm.

4.2.3 Freeboard

The freeboard is to correspond to, at least, the sum of:

a) the additional lateral immersion which, measured on the outside plating, is produced by the angle of heel according to [4.1.3], item e), and

b) the residual freeboard according to [4.1.3], item f).

The freeboard is to be at least 300 mm.

4.2.4 The plane of maximum draught is to be set so as to ensure compliance with the safety clearance according to [4.2.2], and the freeboard according to [4.2.3].

4.2.5 For safety reasons, the Society may stipulate a greater safety clearance or a greater freeboard.

SECTION 3 MATERIALS

1 General

1.1 Characteristics of materials

1.1.1 The characteristics of the materials to be used in the construction of units are to comply with the applicable requirements of NR216 Materials and Welding.

Materials with other characteristics may be accepted, provided their specification (manufacture, chemical composition, mechanical properties, welding, etc.) is submitted to the Society for approval.

1.2 Testing of materials

1.2.1 Materials are to be tested in compliance with the applicable requirements of NR216 Materials and Welding.

1.3 Manufacturing processes

1.3.1 The requirements of this Section presume that welding and other cold or hot manufacturing processes are carried out in compliance with current sound working practice and the applicable requirements of NR216 Materials and Welding. In particular:

- parent material and welding processes are to be within the limits stated for the specified type of material for which they are intended
- specific preheating may be required before welding
- welding or other cold or hot manufacturing processes may need to be followed by an adequate heat treatment.

2 Steels for hull structure

2.1 Application

2.1.1 Tab 1 gives the mechanical characteristics of steels currently used in the construction of floating units.

High strength steels other than those indicated in Tab 1 are considered by the Society on a case-by-case basis.

When steels with a minimum yield stress R_{eH} greater than 235 N/mm² are used, hull scantlings are to be determined, taking into account the material factor k defined in [2.4.1].

When no other information is available, the minimum specified yield stress R_{eH} and the Young's modulus E of steels used at temperatures between 90°C and 300°C may be taken respectively equal to:

$$R_{eH} = R_{eH0}\left(1,04 - \frac{0,75}{1000}\theta\right)$$

$$E = E_0\left(1,03 - \frac{0,5}{1000}\theta\right)$$

where:

R_{eH0} : Value of the minimum specified yield stress at ambient temperature

E_0 : Value of the Young's modulus at ambient temperature

θ : Service temperature, in °C.

Characteristics of steels with specified through thickness properties are given in NR216 Materials and Welding, Ch 2, Sec 1, [9].

Table 1 : Mechanical properties of hull steels

Steel grades (t ≤ 100 mm)	Minimum yield stress R_{eH} , in N/mm²	Ultimate minimum tensile strength R_m , in N/mm²
A - B - D	235	400 - 520
A32 - D32	315	440 - 590
A36 - D36	355	490 - 620
A40 - D40 **(1)**	390	510 - 650
(1) t ≤ 50 mm		

2.2 Information to be kept on board

2.2.1 It is advised to keep on board a plan indicating the steel types and grades adopted for the hull structure. Where steels other than those indicated in Tab 1 are used, their mechanical and chemical properties, as well as any workmanship requirements or recommendations, are to be available on board together with the above plan.

2.3 Dimensional tolerances

2.3.1 For plates and wide flats, an under-thickness tolerance of 0,3 mm is permitted.

For sections and bars, the under-thickness tolerance is to be in accordance with the requirements of a recognized international or national standard.

2.4 Material factor k

2.4.1 Unless otherwise specified, the material factor k is defined in Tab 2, as a function of the minimum specified yield stress ReH.

For intermediate values of R_{eH}, k may be obtained by linear interpolation.

Steels with a yield stress lower than 235 N/mm² or greater than 390 N/mm² are considered by the Society on a case-by-case basis.

Table 2 : Material factor k

R_{eH} , in N/mm^2	k
235	1,00
315	0,78
355	0,72
390	0,68

2.5 Grades of steels

2.5.1 Normal strength steel grades A, B and D

The distribution of the normal strength steel grades used in the central part is indicated in Tab 3.

Steel of grade D may be required for members consisting in plates more than 20 mm thick in areas liable to important static or dynamic stress concentrations.

Table 3 : Distribution of steel grades in the central part Normal strength steels

	$t \leq 15$	$15 < t \leq 20$	$t > 20$
Bilge and topside structure **(1)**	A	B	D
Side shell	A	A	A
Deck and bottom	A	A	B
Deck plates at the hatch corners	A	B	D
t : Structural member gross thickness, in mm. **(1)** Sheerstrake, stringer plate.			

2.5.2 High tensile strength structural steel grades AH and DH

The distribution of the high tensile strength steel grades used in the central part is given in Tab 4.

Outside the central part, the thickness of high tensile strength steel is to be kept unchanged until the region where the thickness of ordinary steel is the same for the unit considered.

Table 4 : Distribution of steel grades in the central part High tensile strength steels

	$t \leq 20$	$t > 20$
Bilge and topside structure **(1)**	AH	DH
Side shell	AH	AH
Deck and bottom	AH	DH
Deck plates at the corners of long hatches	AH	DH
t : Structural member gross thickness, in mm. **(1)** Sheerstrake, stringer plate.		

For strength members not mentioned in these tables, grade A / AH may generally be used.

The steel grade is to correspond to the as-fitted gross thickness when this one is greater than the gross thickness obtained from the net thickness required by the Rules according to Ch 2, Sec 4.

2.5.3 Grades of steel for structures exposed to low temperatures

The selection of steel grades to be used for the structural members exposed to low temperatures (–20°C or below) is to be in compliance with the applicable requirements of NR216 Materials and Welding.

3 Aluminum alloy structures

3.1 Application

3.1.1 The use of aluminium alloys, instead of steel, is normally authorized, provided that equivalent strength is maintained.

The arrangements adopted are to comply, where applicable, with the requirements of the International Conventions and National Regulations.

3.2 Extruded plating

3.2.1 Extrusions with built-in plating and stiffeners, referred to as extruded plating, may be used.

In general, the application is limited to decks, bulkheads, superstructures and deckhouses. Other uses may be permitted by the Society on a case-by-case basis.

Extruded plating is preferably to be oriented so that the stiffeners are parallel to the direction of main stresses.

Connections between extruded plating and primary members are to be given special attention.

3.3 Mechanical properties of weld joints

3.3.1 Welding heat input lowers locally the mechanical strength of aluminium alloys hardened by work hardening (series 5000 other than condition 0 or H111) or by heat treatment (series 6000).

The as-welded properties of aluminium alloys of series 5000 are in general those of condition 0 or H111.

Higher mechanical characteristics may be taken into account, provided they are duly justified.

The as-welded properties of aluminium alloys of series 6000 are to be agreed by the Society.

3.4 Material factor k

3.4.1 The material factor k for aluminium alloys is to be obtained from the following formula:

$$k = \frac{235}{R'_{lim}}$$

where:

R'_{lim} : Minimum specified yield stress of the parent metal in welded condition $R'_{p0,2}$, in N/mm^2, but not to be taken greater than 70% of the minimum specified tensile strength of the parent metal in welded condition R'_m , in N/mm^2

$R'_{p0,2} = \eta_1 R_{p0,2}$

$R'_m = \eta_2 R_m$

$R_{p0,2}$: Minimum specified yield stress, in N/mm², of the parent metal in delivery condition

R_m : Minimum specified tensile stress, in N/mm², of the parent metal in delivery condition.

η_1 and η_2 are given in Tab 5.

Table 5 : Aluminium alloys for welded construction

Aluminium alloy	η_1	η_2
Alloys without work-hardening treatment (series 5000 in annealed condition 0 or annealed flattened condition H111)	1	1
Alloys hardened by work hardening (series 5000 other than condition 0 or H111)	$R'_{p0,2}/R_{p0,2}$	R'_m / R_m
Alloys hardened by heat treatment (series 6000) **(1)**	$R'_{p0,2}/R_{p0,2}$	0,6
(1) When no information is available, coefficient η_1 is to be taken equal to the metallurgical efficiency coefficient β defined in Tab 6. **Note 1:** $R'_{p0,2}$: Minimum specified yield stress, in N/mm², of material in welded condition (see [3.3.1]) R'_m : Minimum specified tensile stress, in N/mm², of material in welded condition (see [3.3.1]).		

Table 6 : Aluminium alloys Metallurgical efficiency coefficient β

Aluminium alloy	Temper condition	Gross thickness, in mm	β
6005 A (Open sections)	T5 or T6	$t \leq 6$	0,45
		$t > 6$	0,40
6005 A (Closed sections)	T5 or T6	All	0,50
6061 (Sections)	T6	All	0,53
6082 (Sections)	T6	All	0,45

In the case of welding of two different aluminium alloys, the material factor k to be considered for the scantlings is the greater material factor of the aluminium alloys of the assembly.

For welded constructions in hardened aluminium alloys (series 5000 other than condition 0 or H111 and series 6000), greater characteristics than those in welded condition may be considered, provided that welded connections are located in areas where stress levels are acceptable for the alloy considered in annealed or welded condition.

3.5 Transition joints

3.5.1 The aluminium material is to comply with the applicable requirements of NR216 Materials and Welding and the steel is to be of an appropriate grade complying with the requirements of these Rules.

Explosion bonded composite aluminium/steel transition joints used for the connection of aluminium structures to steel plating are to comply with the applicable requirements of NR216 Materials and Welding.

The use of rolled bonded composite aluminium/steel transition joints will be examined by the Society on a case by case basis.

4 Other materials

4.1 General

4.1.1 Other materials and products such as parts made of iron castings, where allowed, products made of copper and copper alloys, rivets, cranes, masts, derricks, accessories and wire ropes are generally to comply with the applicable requirements of NR216 Materials and Welding.

4.1.2 The use of plastics, wood or other special materials not covered by these Rules is to be considered by the Society on a case by case basis.

In such a case, the Society states the requirements for the acceptance of the materials concerned.

4.1.3 Materials used in welding processes are to comply with the applicable requirements of NR216 Materials and Welding.

SECTION 4 NET SCANTLING APPROACH

1 Application criteria

1.1 General

1.1.1 The scantlings obtained by applying the criteria specified in these Rules are net scantlings, i.e. those which provide the strength characteristics required to sustain the loads, excluding any addition for corrosion. Exceptions are the scantlings of massive pieces made of steel forgings, steel castings or iron castings

The required strength characteristics are:

- thickness, for plating including that which constitutes primary supporting members
- section modulus, shear sectional area, moments of inertia and local thickness, for ordinary stiffeners and, as the case may be, primary supporting members
- section modulus, moments of inertia and single moment for the hull girder.

The unit is to be built at least with the gross scantlings obtained by reversing the procedure described in [2.1.1].

2 Net strength characteristic calculation

2.1 Designer's proposals based on gross scantlings

2.1.1 If the designer provides the gross scantlings of each structural element, the structural checks are to be carried out on the basis of the net strength characteristics, derived as specified here below:

a) Plating

The net thickness is to be obtained by deducting the corrosion addition t_c from the gross thickness.

b) Ordinary stiffeners

The net transverse section is to be obtained by deducting the corrosion addition t_C from the gross thickness of the elements which constitute the stiffener profile.

The net strength characteristics are to be calculated for the net transverse section. As an alternative, the net section modulus of bulb profiles may be obtained from the following formula:

$$w = w_G (1 - \alpha\, t_C) - \beta\, t_C$$

where:

w_G : Stiffener gross section modulus, in cm^3

α, β : Coefficients defined in Tab 1.

c) Primary supporting members

The net transverse section is to be obtained by deducting the corrosion addition t_C from the gross thickness of the elements which constitute the primary supporting members.

The net strength characteristics are to be calculated for the net transverse section.

d) Hull girder

For the hull girder, the net hull transverse sections are to be considered as being constituted by plating and stiffeners having net scantlings calculated on the basis of the corrosion additions t_C.

Table 1 : Coefficients α and β for bulb profiles

Range of section modulus	α	β
$w_G \leq 200$ cm^3	0,070	0,4
$w_G > 200$ cm^3	0,035	7,4

2.2 Designer's proposals based on net scantlings

2.2.1

a) Net strength characteristics and corrosion additions

If the designer provides the net scantlings of each structural element, the structural checks are to be carried out on the basis of the proposed net strength characteristics.

The designer is also to provide the corrosion additions or the gross scantlings of each structural element. The proposed corrosion additions are to be not less than the values specified in [3.1.1].

b) Hull girder net strength characteristic calculation

For the hull girder, the net hull girder transverse sections are to be considered as being constituted by plating and stiffeners having the net scantlings proposed by the designer.

3 Corrosion additions

3.1 Values of corrosion additions

3.1.1 General

The values of the corrosion additions specified in this Article are to be applied in relation to the relevant corrosion protection measures.

The designer may define values of corrosion additions greater than those specified here below.

3.1.2 Corrosion additions for steels other than stainless steel

The corrosion addition for each of the two sides of a structural member, t_{C1} or t_{C2} , is specified in Tab 2.

- for plating with a gross thickness greater than 10 mm, the total corrosion addition t_C, in mm, for both sides of the structural member is obtained by the following formula:

  $t_C = t_{C1} + t_{C2}$
- for plating with a gross thickness less than or equal to 10 mm, the smallest of the following values:
  - 20% of the gross thickness of the plating
  - $t_C = t_{C1} + t_{C2}$

For an internal member within a given compartment, the total corrosion addition t_C is to be determined as specified here below, where t_{C1} is the value of the corrosion addition specified in Tab 2 for one side exposure to that compartment:

- for plating/stiffener plating with a gross thickness greater than 10 mm, the total corrosion addition t_C, in mm, is twice the value of t_{C1}:

  $t_C = 2\ t_{C1}$
- for plating/stiffener plating with a gross thickness less than or equal to 10 mm, the smallest of the following values:
  - 20% of the gross thickness of the plating / stiffener plating
  - $t_C = 2\ t_{C1}$

3.1.3 Corrosion additions for stainless steel and aluminium

For structural members made of stainless steel or aluminium alloys, the corrosion addition is to be taken equal to 0.

Table 2 : Corrosion additions, in mm, for one side exposure (t_{C1} or t_{C2})

Compartment type		Corrosion addition **(1)**
Ballast tank		1,00
Fuel oil tank	Plating of horizontal surfaces	0,75
	Plating of non-horizontal surfaces	0,50
	Ordinary stiffeners and primary supporting members	0,75
Accommodation space		0,00
Compartments and areas other than those mentioned above		0,50
(1) Corrosion additions are applicable to all members of the considered item.		

SECTION 5 STRENGTH PRINCIPLES

1 General strength principles

1.1 Structural continuity

1.1.1 The variation in scantlings between the midship region and the end parts is to be gradual.

1.1.2 The structural continuity is to be ensured:

- in way of changes in the framing system
- at the connections of primary or ordinary stiffeners
- in way of the ends of the fore and aft parts and machinery space
- in way of ends of superstructures.

1.1.3 Longitudinal members contributing to the hull girder longitudinal strength, according to Ch 4, Sec 1, [3], are to extend continuously for a sufficient distance towards the ends of the unit.

Ordinary stiffeners contributing to the hull girder longitudinal strength are generally to be continuous when crossing primary supporting members. Otherwise, the detail of connections is considered by the Society on a case by case basis.

Longitudinals of the bottom, bilge, sheerstrake, deck, upper and lower longitudinal bulkhead and inner side strakes, as well as the latter strakes themselves, the lower strake of the centreline bottom girder and the upper strake of the centreline deck girder, where fitted, are to be continuous through the transverse bulkheads of the central part and cofferdams. Alternative solutions may be examined by the Society on a case by case basis, provided they are equally effective.

1.1.4 Where stress concentrations may occur in way of structural discontinuities, adequate compensation and reinforcements are to be provided.

1.1.5 Openings are to be avoided, as far as practicable, in way of highly stressed areas.

Where necessary, the shape of openings is to be specially designed to reduce the stress concentration factors.

Openings are to be generally well rounded with smooth edges.

1.1.6 Primary supporting members are to be arranged in such a way that they ensure adequate continuity of strength. Abrupt changes in height or in cross-section are to be avoided.

1.2 Connections with higher strength steel

1.2.1 Outside the higher strength steel area, scantlings of longitudinal elements in normal strength steel are to be calculated assuming that the midship area is made in normal strength steel.

1.2.2 Regarding welding of higher strength hull structural steel, see applicable requirements of NR216 Materials and Welding.

1.3 Connections between steel and aluminium

1.3.1 Any direct contact between steel and aluminium alloy is to be avoided (e.g. by means of zinc or cadmium plating of the steel parts and application of a suitable coating on the corresponding light alloy parts).

1.3.2 Any heterogeneous jointing system is considered by the Society on a case by case basis.

1.3.3 The use of transition joints made of aluminium/steel clad plates or profiles is considered by the Society on a case by case basis (see also Ch 2, Sec 3, [3.5.1]).

2 Plating

2.1 Insert plates and doublers

2.1.1 A local increase in plating thickness is generally to be achieved through insert plates. Local doublers, which are normally only allowed for temporary repair, may however be accepted by the Society on a case by case basis.

In any case, doublers and insert plates are to be made of materials of a quality at least equal to that of the plates on which they are welded.

2.1.2 Doublers having width, in mm, greater than:

- 20 times their thickness, for thicknesses equal to or less than 15 mm
- 25 times their thickness, for thicknesses greater than 15 mm

are to be fitted with slot welds, in accordance with the Rules.

2.1.3 When doublers fitted on the outer shell and strength deck within 0,5 L amidships are accepted by the Society, their width and thickness are to be such that slot welds are not necessary according to the requirements in [2.1.2]. Outside this area, the possibility of fitting doublers requiring slot welds will be considered by the Society on a case by case basis.

3 Ordinary stiffeners

3.1 General

3.1.1 Stiffener not perpendicular to the attached plating

Where the angle between the section web and the attached plating is less than 70°, the actual section modulus may be obtained, in cm³, from the following formula:

$w = w_0 \sin \alpha$

where:

w_0 : Actual section modulus, in cm³, of the stiffener assumed to be perpendicular to the plating

α : Angle between the stiffener web and the attached plating, to be measured at mid-span of the section.

3.2 Span of ordinary stiffeners

3.2.1 General

The span ℓ of ordinary stiffeners is to be measured as shown in Fig 1 to Fig 4.

Figure 1 : Ordinary stiffener without brackets

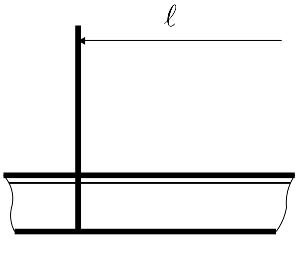


Figure 2 : Ordinary stiffener with a stiffener at one end

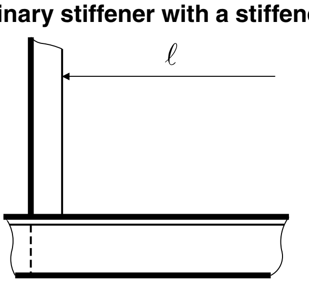


Figure 3 : Ordinary stiffener with end bracket

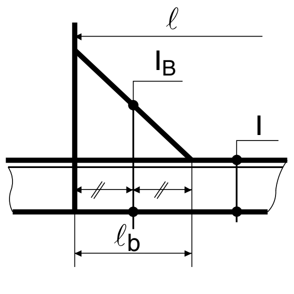
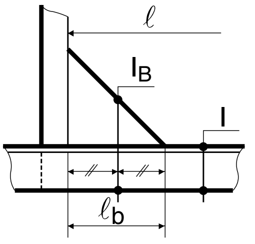


Figure 4 : Ordinary stiffener with a bracket and a stiffener at one end



3.3 Width of attached plating

3.3.1 Yielding check

The width of the attached plating to be considered for the yielding check of ordinary stiffeners is to be obtained, in m, from the following formulae:

- where the plating extends on both sides of the ordinary stiffener:

  $b_P = s$

- where the plating extends on one side of the ordinary stiffener (i.e. ordinary stiffeners bounding openings):

  $b_P = 0{,}5\ s$

3.3.2 Buckling check

The attached plating to be considered for the buckling check of ordinary stiffeners is defined in NR217, Pt B, Ch 2, Sec 6, [2.3].

3.4 Sections

3.4.1 The main characteristics of sections currently used are given in NR217, Ch 2, App 1.

3.5 End connections

3.5.1 Continuous ordinary stiffeners

Where ordinary stiffeners are continuous through primary supporting members, they are to be connected to the web plating so as to ensure proper transmission of loads, e.g. by means of one of the connection details shown in Fig 5 to Fig 8. In the case of high values for the design loads, additional stiffening is required.

Connection details other than those shown in Fig 5 to Fig 8 may be considered by the Society on a case by case basis. In some cases, the Society may require the details to be supported by direct calculations submitted for review.

Figure 5 : End connection of ordinary stiffener Without collar plate

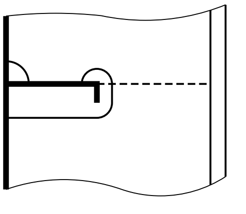


Figure 6 : End connection of ordinary stiffener Collar plate

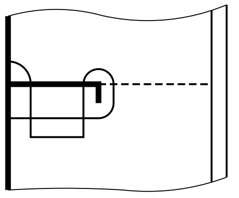


Figure 7 : End connection of ordinary stiffener One large collar plate

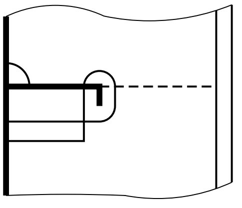
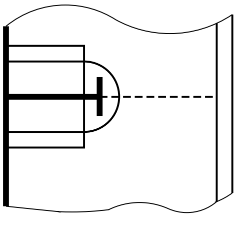


Figure 8 : End connection of ordinary stiffener Two large collar plates



3.5.2 Intercostal ordinary stiffeners

Where ordinary stiffeners are cut at primary supporting members, brackets are to be fitted to ensure the structural continuity. Their section modulus and their sectional area are to be not less than those of the ordinary stiffeners.

All brackets for which:

$$\frac{\ell_{bf}}{t} > 60$$

where:

ℓ_{bf} : Length, in mm, of the free edge of the bracket

t : Bracket net thickness, in mm

are to be flanged or stiffened by a welded face plate.

The sectional area, in cm², of the flange or the face plate is to be not less than 0,01 ℓ_{bf}.

The width of the face plate is to be not less than 10 t.

3.5.3 Sniped ends of stiffeners

Stiffeners may be sniped at the ends if the net thickness of the plating supported by the stiffener is not less than:

$$t = c\sqrt{\frac{psk(\ell - 0,5s)}{235}}$$

where:

p : Stiffener design load, in kN/m², to be determined in compliance with Ch 3, Sec 3, [1]

c : Coefficient to be taken equal to:

- c = 12,7 for watertight bulkheads
- c = 15,7 for all other components.

4 Primary supporting members

4.1 Span of primary supporting members

4.1.1 The span of primary supporting members is to be determined in compliance with [3.2].

4.2 Width of attached plating

4.2.1 General

The width of the attached plating of primary supporting members is to be obtained according to [4.2.2] or [4.2.3], depending on the type of loading, where:

S_0 : S_0 = S, for plating extending on both sides of the primary supporting member

S_0 = 0,5 S, for plating extending on one side of the primary supporting member

S_1 : S_1 = 0,2 ℓ, for plating extending on both sides of the primary supporting member

S_1 = 0,1 ℓ, for plating extending on one side of the primary supporting member.

4.2.2 Loading type 1

Where the primary supporting members are subjected to uniformly distributed loads or else by not less than 6 equally spaced concentrated loads, the width of the attached plating is to be obtained, in m, from the following formulae:

- $\ell / S_0 \leq 4$:

$$b_P = 0,36 S_0 \left(\frac{\ell}{S_0}\right)^{0,67}$$

- $\ell / S_0 > 4$:

b_P = MIN (S_0 ; S_1)

4.2.3 Loading type 2

Where the primary supporting members are subjected to less than 6 concentrated loads, the width of the attached plating is to be obtained, in m, from the following formulae:

- $\ell / S_0 < 8$:

$$b_P = 0,205 S_0 \left(\frac{\ell}{S_0}\right)^{0,72}$$

- $\ell / S_0 \geq 8$:

$b_P = 0,9\ S_0$

4.2.4 Corrugated bulkheads

The width of attached plating of corrugated bulkhead primary supporting members is to be determined as follows:

- when primary supporting members are parallel to the corrugations and are welded to the corrugation flanges, the width of the attached plating is to be calculated in accordance with [4.2.2] and [4.2.3] and is to be taken not greater than the corrugation flange width
- when primary supporting members are perpendicular to the corrugations, the width of the attached plating is to be taken equal to the width of the primary supporting member face plate.

4.3 Bracketed end connections

4.3.1 Arm lengths of end brackets are to be equal, as far as practicable.

The height of end brackets is to be not less than that of the weakest primary supporting member.

4.3.2 The scantlings of end brackets are generally to be such that the section modulus of the primary supporting member with end brackets is not less than that of the primary supporting member at mid-span.

4.3.3 The bracket web thickness is to be not less than that of the weakest primary supporting member.

4.3.4 The face plate of end brackets is to have a width not less than the width of the primary supporting member faceplates.

Moreover, the thickness of the face plate is to be not less than that of the bracket web.

4.3.5 In addition to the above requirements, the scantlings of end brackets are to comply with the applicable requirements of this Chapter.

4.4 Bracketless end connections

4.4.1 In the case of bracketless end connections between primary supporting members, the strength continuity is to be obtained as schematically shown in Fig 9 or by any other method which the Society may consider equivalent.

4.4.2 In general, the continuity of the face plates is to be ensured.

4.5 Stiffening arrangement

4.5.1 Webs of primary supporting members are generally to be stiffened where the height, in mm, is greater than 100t, where t is the web net thickness, in mm, of the primary supporting member.

In general, the web stiffeners of primary supporting members are to be spaced not more than 110t.

4.5.2 Where primary supporting member web stiffeners are welded to ordinary stiffener face plates, their net sectional area at the web stiffener mid-height is to be not less than the value obtained, in cm², from the following formula:

$$A = 0{,}1 k_1 p s \ell$$

where:

k_1 : Coefficient depending on the web connection with the ordinary stiffener, to be taken as:

- k_1 = 0,30 for connections without collar plate (see Fig 5)
- k_1 = 0,225 for connections with a collar plate (see Fig 6)
- k_1 = 0,20 for connections with one or two large collar plates (see Fig 7 and Fig 8)

p : Design pressure, in kN/m², acting on the ordinary stiffener, defined in Ch 3, Sec 3, [1].

4.5.3 The net section modulus of web stiffeners of non-watertight primary supporting members is to be not less than the value obtained, in cm³, from the following formula:

$$w = 2{,}5\, h^2\, t\, S_s^2$$

where:

h : Length, in m, of web stiffeners

t : Web net thickness, in mm, of the primary supporting member

S_s : Spacing, in m, of web stiffeners.

Moreover, web stiffeners located in areas subject to compression stresses are to be checked for buckling.

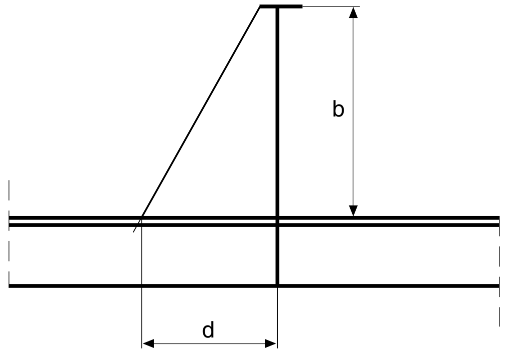
4.5.4 Tripping brackets (see Fig 10) welded to the face plate are generally to be fitted:

- every fourth spacing of ordinary stiffeners, without exceeding 4 m
- in way of concentrated loads.

Where the width of the symmetrical face plate is greater than 400 mm, backing brackets are to be fitted in way of the tripping brackets.

Figure 9 : Connection of two primary supporting members

Figure 10 : Primary supporting member: web stiffener in way of ordinary stiffener



4.5.5 In general, the width of the primary supporting member face plate is to be not less than one tenth of the depth of the web, where tripping brackets are spaced as specified in [4.5.4].

4.5.6 The arm length of tripping brackets is to be not less than the greater of the following values, in m:

$$d = 0,38b$$

$$d = 0,85b\sqrt{\frac{s_t}{t}}$$

where:

- b : Height, in m, of tripping brackets, shown in Fig 10
- s_t : Spacing, in m, of tripping brackets
- t : Net thickness, in mm, of tripping brackets.

4.5.7 Tripping brackets with a net thickness, in mm, less than $15L_b$ are to be flanged or stiffened by a welded face plate.

The net sectional area, in cm^2, of the flanged edge or the face plate is to be not less than $10L_b$, where L_b is the length, in m, of the free edge of the bracket.

SECTION 6 BOTTOM STRUCTURE

1 General

1.1 Application

1.1.1 The requirements of this Section apply to longitudinally or transversely framed single and double bottom structures.

1.2 Scantlings

1.2.1 The scantlings of bottom and double bottom structural members are to comply with Part B, Chapter 5.

1.3 General arrangement

1.3.1 The bottom structure is to be checked by the designer to make sure that it withstands the loads resulting from the dry-docking of the unit.

1.3.2 The bottom is to be locally stiffened where concentrated loads are envisaged.

1.3.3 Girders or floors are to be fitted under each line of pillars, when deemed necessary by the Society on the basis of the loads carried by the pillars.

1.3.4 Adequate tapering is to be provided between double bottom and adjacent single bottom structures. Similarly, adequate continuity is to be provided in the case of height variation in the double bottom. Where such a height variation occurs within 0,6 L amidships, the inner bottom is generally to be maintained continuous by means of inclined plating.

1.3.5 Provision is to be made for the free passage of water from all parts of the bottom to the suctions, taking into account the pumping rate required.

1.4 Drainage and openings for air passage

1.4.1 Holes are to be cut into floors and girders to ensure the free passage of air and liquids from all parts of the double bottom.

2 Transversely framed single bottom

2.1 Floors

2.1.1 Floors are to be fitted at every frame.

In the case of vessels with rise of floor, the floor height may be required to be increased so as to assure a satisfactory connection to the side frames.

2.2 Centre girder

2.2.1 All single bottom units are to have a centre girder. The Society may waive this rule for units with B_F less than 6 m, when the floor is a rolled section or when the floor stability is covered otherwise, where B_F is the breadth of the unit, in m, measured on the top of floor.

The web depth of the centre girder has to extend to the floor plate upper edge. The web thickness is not to be less than that of the floor plates.

Centre girder is to be fitted with a face plate or a flange, the net sectional area of which, in cm², is not to be less than:

$A_f = 0{,}6\ L + 2{,}7$

2.3 Side girders

2.3.1 Depending on the breadth B_F defined in [2.2.1], side girders are to be fitted in compliance with the following:

- $B_F \leq 6$ m: no side girder
- 6 m $< B_F \leq 9$ m: one side girder at each side
- $B_F > 9$ m: two side girders at each side.

Side girders are to be fitted with a face plate or a flange, the net sectional area of which is not to be less than that of the floor plate.

Centre and side girders are to be extended as far aft and forward as practicable.

Intercostal web plates of centre and side girders are to be aligned and welded to floors.

Where two girders are slightly offset, they are to be shifted over a length at least equal to two frame spacings.

Towards the ends, the thickness of the web plate as well as the sectional area of the top plate may be reduced by 10%. Lightening holes are to be avoided.

Where side girders are fitted in lieu of the centre girder, the scarfing is to be adequately extended and additional stiffening of the centre bottom may be required.

3 Longitudinally framed single bottom

3.1 Bottom longitudinals

3.1.1 Longitudinal ordinary stiffeners are generally to be continuous when crossing primary supporting members.

The section modulus of longitudinals located in way of the web frames of transverse bulkheads is to be increased by 10%.

The Society may call for strengthening of the longitudinal located in the centreline of the unit.

3.2 Bottom transverses

3.2.1 In general, the transverse spacing is to be not greater than 8 frame spacings, nor than 4m, which is the lesser.

Where the ratio of the bottom transverse web height to its net thickness exceeds 100, the bottom transverse web is to be provided with stiffeners in way of longitudinals in compliance with Ch 2, Sec 5, [4.5.1], Ch 2, Sec 5, [4.5.2] and Ch 2, Sec 5, [4.5.3], as applicable. The stiffeners are to extend between the longitudinals and the upper faceplate of the transverse, without any connection with that faceplate.

In the case of units with rise of floor, the bottom transverse height may be required to be increased so as to assure a satisfactory connection to the side transverses.

3.3 Bottom Girders

3.3.1 The requirements in [2.2] and [2.3] apply also to longitudinally framed single bottoms, with transverses instead of floors.

4 Transversely framed double bottom

4.1 Double bottom arrangement

4.1.1 Where the height of the double bottom varies in the longitudinal direction, the variation is to be made gradually over an adequate length.

The knuckles of inner bottom plating are to be located in way of plate floors. Where this is impossible, suitable longitudinal structures such as partial girders, longitudinal brackets etc., fitted across the knuckle are to be arranged.

For units without a flat bottom, the height of double bottom may be required to be adequately increased such as to ensure sufficient access to the areas towards the sides.

Adequate strength continuity of floors is to be ensured in way of the side tank by means of brackets.

4.2 Floors

4.2.1 Floors are to be fitted at every frame.

Watertight floors are to be fitted:

- in way of transverse watertight bulkheads
- in way of double bottom steps.

In general, floors are to be continuous.

Where the double bottom height does not enable to connect the floors and girders to the inner bottom by fillet welding, slot welding may be used. In that case, the floors and girders are to be fitted with a face plate or a flange.

4.3 Bilge wells

4.3.1 Bilge wells arranged in the double bottom are to be limited in depth and formed by steel plates having a thickness not less than the greater of that required for watertight floors and that required for the inner bottom.

In units subject to stability requirements, such bilge wells are to be fitted so that the distance of their bottom from the shell plating is not less than 400 mm.

4.4 Girders

4.4.1 A centre girder is to be fitted on all units exceeding 6 m in breadth.

This centre girder is to be formed by a vertical intercostal plate connected to the bottom plating and to double bottom top.

The intercostal centre girder is to extend over the full length of the unit or over the greatest length consistent with the lines. It is to have the same thickness as the floors. No manholes are to be provided into the centre girder.

Units built in the transverse system without web frames are to be fitted with partial intercostal girders in way of the transverse bulkheads of the side tanks, in extension of the inner sides. These girders are to be extended at each end by brackets having a length equal to one frame spacing. They are to have a net thickness equal to that of the inner sides.

5 Longitudinally framed double bottom

5.1 General

5.1.1 The requirements in [4.1], [4.3] and [4.4] are applicable to longitudinally framed double bottoms.

5.2 Transverses

5.2.1 The spacing of transverses, in m, is generally to be not greater than 8 frame spacings nor 4 m, whichever is the lesser.

Additional transverses are to be fitted in way of transverse watertight bulkheads.

Where the ratio of the bottom transverse web height to its net thickness exceeds 100, the bottom transverse web is to be provided with stiffeners in way of longitudinals in compliance with Ch 2, Sec 5, [4.5.1], Ch 2, Sec 5, [4.5.2] and Ch 2, Sec 5, [4.5.3], as applicable. The stiffeners are to extend between the longitudinals and the upper faceplate of the transverse, without any connection with that faceplate.

5.3 Bottom and inner bottom longitudinal ordinary stiffeners

5.3.1 Bottom and inner bottom longitudinal ordinary stiffeners are generally to be continuous through the transverses.

In the case the longitudinals are interrupted in way of a transverse, brackets on both sides of the transverse are to be fitted in perfect alignment.

5.4 Brackets to centreline girder

5.4.1 In general, intermediate brackets are to be fitted connecting the centre girder to the nearest bottom and inner bottom ordinary stiffeners.

Such brackets are to be stiffened at the edge with a flange having a width not less than 1/10 of the local double bottom height.

If necessary, the Society may require a welded flat bar to be arranged in lieu of the flange.

SECTION 7 SIDE STRUCTURE

1 General

1.1 Application

1.1.1 The requirements of this Section apply to longitudinally or transversely framed single and double side structures of floating establishments.

1.2 Scantlings

1.2.1 The scantlings of side and inner side structural members are to comply with Part B, Chapter 5.

A thicker sheerstrake may be waived if an efficient fender is fitted in way of the main deck.

1.3 General arrangement

1.3.1 The transversely framed side structures are built with transverse frames possibly supported by struts, side stringers and web frames.

1.3.2 The longitudinally framed side structures are built with longitudinal ordinary stiffeners supported by side vertical primary supporting members.

2 Transversely framed single side

2.1 Side frames

2.1.1 Transverse frames are to be fitted at every frame.

2.1.2 Continuity

Frames are generally to be continuous when crossing primary supporting members.

Otherwise, the detail of the connection is to be examined by the Society on a case by case basis.

The frames are to be connected to the floors in accordance with Fig 1, or in an equivalent way.

For overlapping connection as to Fig 1 sketches b and c, a fillet weld run all around has to be provided.

At the upper end of frames, connecting brackets are to be provided in compliance with [6].

In the case of longitudinally framed deck, connecting brackets are to extend up to the deck longitudinal most at side.

When a side stringer is fitted at about mid-span of the frame, the required section modulus of the frame may be reduced by 20%.

In the case of a longitudinally framed single bottom, the side frames are to be connected to the bottom longitudinal most at side, either directly or by means of a bracket, in accordance with Fig 2.

2.2 Side stringers

2.2.1 Side stringers, if fitted, are to be flanged or stiffened by a welded face plate.

The side stringers are to be connected to the frames by welds, either directly or by means of collar plates.

2.3 Web frames

2.3.1 Web frames are to be fitted with a spacing, in m, not greater than 5 m.

For a construction on the combination system, side web frames are to be provided in way of bottom transverses.

Where the web frames are connected to the floors or the strong beams, web frame strength continuity is to be ensured according to Ch 2, Sec 5, [4.4].

Figure 1 : Connection with floors

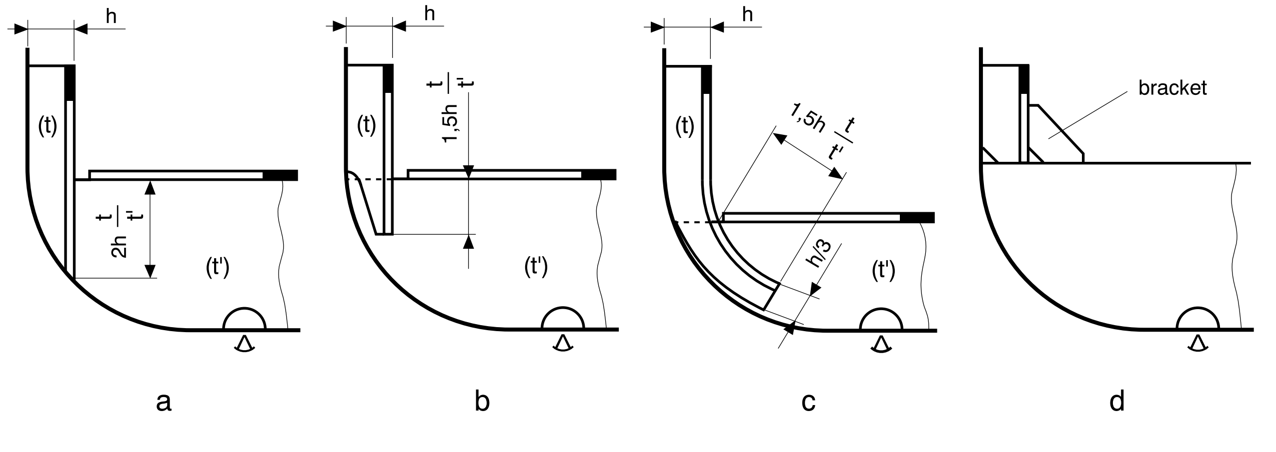
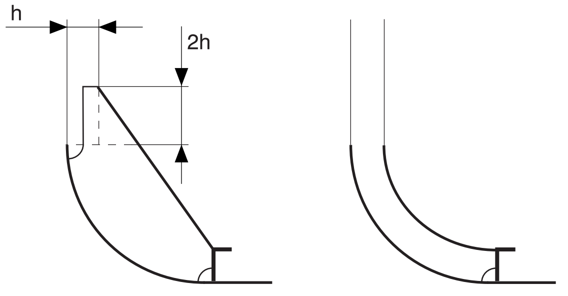


Figure 2 : Connection of frames to bottom longitudinals



3 Longitudinally framed single side

3.1 Side transverses

3.1.1 Side transverses are to be fitted:

- in general, with a spacing not greater than 8 frame spacings, nor than 4m
- in way of hatch end beams.

The side transverses are generally directly welded to the shell plating.

In the case of a double bottom, the side transverses are to be bracketed to the bottom transverses.

3.2 Side longitudinals

3.2.1 Longitudinal ordinary stiffeners are generally to be continuous when crossing primary supporting members.

In the case the longitudinals are interrupted by a primary supporting member, brackets on both sides of the primary supporting member are to be fitted in perfect alignment.

The section modulus of side longitudinals located in way of the stringers of transverse bulkheads is to be increased by 20%.

4 Transversely framed double side

4.1 General

4.1.1 Adequate continuity of strength is to be ensured in way of breaks or changes in width of the double side.

In particular, scarfing of the inner side is to be ensured beyond the centre part.

4.2 Side and inner side frames

4.2.1 Side frames may be connected to the inner side frames by means of struts having a sectional area not less than those of the connected frames.

Struts are generally to be connected to side and inner side frames by means of vertical brackets or by appropriate weld sections.

Where struts are fitted between side and inner side frames at mid-span, the section modulus of side frames and inner side frames may be reduced by 30%.

4.3 Side and inner side web frames

4.3.1 It is recommended to provide web frames, fitted every 3 m and in general not more than 6 frame spacings apart.

In any case, web frames are to be fitted in way of strong deck beams.

At their upper end, side and inner side web frames are to be connected by means of a bracket. This bracket can be a section or a flanged plate with a section modulus at least equal to that of the web frames.

At mid-span, the web frames are to be connected by means of struts, the cross sectional area of which is not to be less than those of the connected web frames.

At their lower end, the web frames are to be adequately connected to the floors.

5 Longitudinally framed double side

5.1 General

5.1.1 The requirements in [4.1.1] also apply to longitudinally framed double side.

5.2 Side and inner side longitudinals

5.2.1 Side longitudinals may be connected to the inner side longitudinals by means of struts having a sectional area not less than those of the connected longitudinals.

Struts are generally to be connected to side and inner side longitudinals by means of brackets or by appropriate weld sections.

Where struts are fitted between side and inner side longitudinals at mid-span, the section modulus of side longitudinals and inner side longitudinals may be reduced by 30%.

5.3 Side transverses

5.3.1 The requirements in [4.3.1] also apply to longitudinally framed double side, with side transverses instead of side web frames.

6 Frame connections

6.1 General

6.1.1 End connections

At their lower end, frames are to be connected to floors, by means of lap weld or by means of brackets.

At the upper end of frames, connecting brackets are to be provided, in compliance with [6.2]. In the case of open deck vessels, such brackets are to extend to the hatch coaming.

Brackets are normally connected to frames by lap welds. The length of overlap is to be not less than the depth of frames.

6.1.2 Brackets

The same minimum value d is required for both arm lengths of straight brackets. Straight brackets may therefore have equal sides.

A curved bracket is to be considered as the largest equal-sided bracket contained in the curved bracket.

6.2 Upper and lower brackets of frames

6.2.1 The arm length of upper brackets, connecting frames to deck beams, and the lower brackets, connecting frames to the inner bottom or to the face plate of floors is to be not less than the value obtained, in mm, from the following formula:

$$d = \varphi\sqrt{\frac{w+30}{t}}$$

where:

φ : Coefficient equal to:
- for unflanged brackets:
  $\varphi = 50$
- for flanged brackets:
  $\varphi = 45$

w : Required net section modulus of the stiffener, in cm³, given in [6.2.2] and depending on the type of connection

t : Bracket net thickness, in mm, to be taken not less than the stiffener thickness.

6.2.2 Section modulus of connections

For connections of perpendicular stiffeners located in the same plane (see Fig 3) or connections of stiffeners located in perpendicular planes (see Fig 4), the required section modulus is to be taken equal to:

$w = w_2$ if $w_2 \le w_1$

$w = w_1$ if $w_2 > w_1$

where w_1 and w_2 are the required net section moduli of stiffeners, as shown in Fig 3 and Fig 4.

6.2.3 All brackets for which:

$$\frac{\ell_b}{t} > 60$$

where:

ℓ_b : Length, in mm, of the free edge of the bracket

t : Bracket net thickness, in mm,

are to be flanged or stiffened by a welded face plate.

The sectional area, in cm², of the flange or the face plate is to be not less than $0{,}01\ \ell_b$.

The width of the face plate, in mm, is to be not less than 10 t.

Figure 3 : Connections of perpendicular stiffeners in the same plane

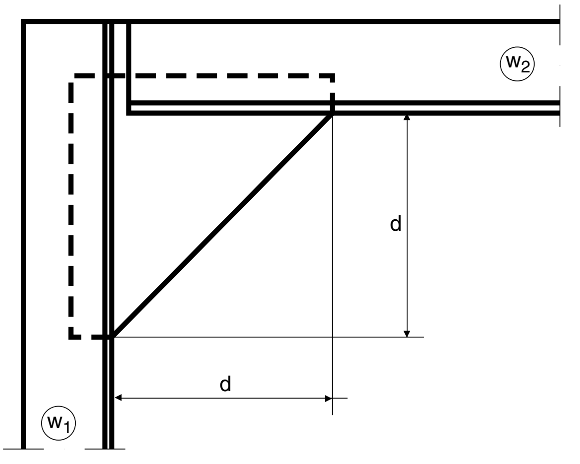
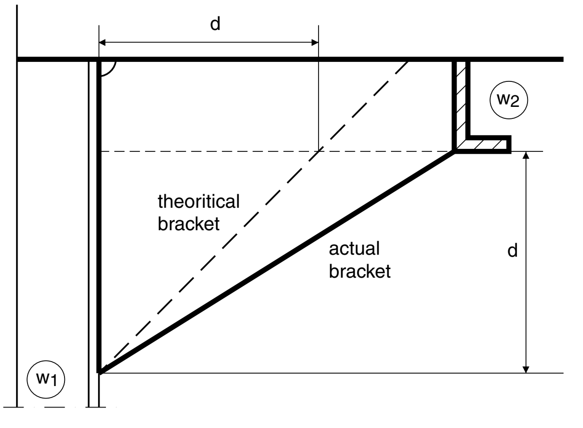


Figure 4 : Connections of stiffeners located in perpendicular planes



SECTION 8 DECK STRUCTURE

1 General

1.1 Application

1.1.1 The requirements of this Section apply to longitudinally or transversely framed deck structures.

1.2 Scantlings

1.2.1 The scantlings of deck structural members are to comply with Part B, Chapter 5.

1.3 General arrangement

1.3.1 The deck supporting structure consists of ordinary stiffeners (beams or longitudinals), longitudinally or transversely arranged, supported by primary supporting members which may be sustained by pillars.

1.3.2 Where beams are fitted in a hatched deck, these are to be effectively supported by at least two longitudinal girders located in way of hatch side girders to which they are to be connected by brackets and/or clips.

1.3.3 Adequate continuity of strength is to be ensured in way of:

- stepped strength decks
- changes in the framing system.

Details of structural arrangements are to be submitted for review/approval to the Society.

1.3.4 Where applicable, deck transverses of reinforced scantlings are to be aligned with floors.

1.3.5 Inside the line of openings, a transverse structure is generally to be adopted for cross-deck structures, beams are to be adequately supported by girders and, in units greater than 120 m in length, extend up to the second longitudinal from the hatch side girders toward the bulwark.

Where this is impracticable, intercostal stiffeners are to be fitted between the hatch side girder and the second longitudinal.

Other structural arrangements may be accepted, subject to their strength verification. In particular, their buckling strength against the transverse compression loads is to be checked. Where needed, deck transverses may be required to be fitted.

1.3.6 Deck supporting structures under deck machinery, cranes and king posts are to be adequately stiffened.

1.3.7 Pillars or other supporting structures are generally to be fitted under heavy concentrated loads.

1.3.8 Special arrangements, such as girders supported by cantilevers, are considered by the Society on a case by case basis.

1.3.9 Stiffeners are also to be fitted in way of the ends and corners of deck houses and partial superstructures.

1.3.10 Manholes and flush deck plugs

Manholes and flush deck plugs exposed to the weather are to be fitted with steel covers of efficient construction capable of ensuring tightness. These covers are to be fitted with permanent securing device, unless they are secured with closed spaced bolts.

1.3.11 Scuppers

Scuppers on the weather deck and terminating outside the hull are to be made of pipes the gross thickness of which, as a rule, is not to be less than that of the side plating under the sheerstrake but, however needs not exceed 8 mm.

See also Ch 6, Sec 3, [5].

1.3.12 Stringer plate openings

The openings made in the stringer plate other than scupper openings are to be wholly compensated to the satisfaction of the Society.

1.4 Coaming of separate hatchways

1.4.1 Height

The coaming upper edge is not to be less than 300 mm above the deck.

Furthermore, the height of the hatch coaming, h_C, above the deck is to comply with the following:

$z_C \geq T + 0{,}45$

1.4.2 Net thickness

The net thickness of the coaming boundaries is not to be less than:

$t = 0{,}25\ a + 3 \leq 5$ mm,

a being the greater dimension of the hatchway, in m.

1.4.3 Stiffening

The coaming boundaries are to be stiffened with an horizontal stiffening member close to the coaming upper edge. In the case the coaming is higher than 750 mm, a second stiffener is to be fitted at about 0,75 times the hatch coaming height.

The coaming boundaries are to be stiffened with stays, the ends of which are to be connected to the deck and to the upper horizontal stiffeners.

Where necessary, stiffeners are to be provided under deck in way of the stays.

1.4.4 Strength continuity

Arrangements are to be made to ensure strength continuity of the top structure, at the end of large-size hatchways, mainly by extending the deck girders along the hatchway, beyond the hatchways, up to the end bulkhead or over two frame spacings, whichever is greater.

2 Transversely framed deck

2.1 Deck beams

2.1.1 In general, deck beams or deck half-beams are to be fitted at each frame.

2.2 Deck girders

2.2.1 Where deck beams are fitted in a hatched deck, they are to be effectively supported by longitudinal girders located in way of hatch side girders to which they are to be connected by brackets and/or clips.

Deck girders subjected to concentrated loads are to be adequately strengthened.

Deck girders are to be fitted with tripping stiffeners or brackets:

- spaced not more than 20 times the girder faceplate width
- in way of concentrated loads and pillars.

Where a deck girder comprises several spans and its scantlings vary from one span to another, the connection of two different parts is to be effected gradually by strengthening the weaker part over a length which, as a rule, is to be equal to 25% of its length.

The connection of girders to the supports is to ensure correct stress transmission. In particular, connection to the bulkheads is to be obtained by means of flanged brackets having a depth equal to twice that of the deck girder and the thickness of the girder, or by any equivalent method.

3 Longitudinally framed deck

3.1 Deck longitudinals

3.1.1 Deck longitudinals are to be continuous, as far as practicable, in way of deck transverses and transverse bulkheads.

Other arrangements may be considered, provided adequate continuity of longitudinal strength is ensured.

The section modulus of deck longitudinals located in way of the web frames of transverse bulkheads is to be increased by 20%.

Frame brackets, in vessels with transversely framed sides, are generally to have their horizontal arm extended to the adjacent longitudinal ordinary stiffener.

3.2 Deck transverses

3.2.1 In general, the spacing of deck transverses is not to exceed 8 frame spacings or 4 m, whichever is the lesser.

Where applicable, deck transverses of reinforced scantlings are to be aligned with bottom transverses.

The section modulus of transverse parts in way of the stringer plate is not to be less than the rule value obtained by determining them as deck transverses or as side shell transverses, whichever is greater.

4 Pillars

4.1 General

4.1.1 Pillars are to be fitted, as far as practicable, in the same vertical line.

4.1.2 In general, pillars are to be fitted below winches, cranes, in the engine room and at the corners of deckhouses.

4.1.3 In tanks, solid or open section pillars are generally to be fitted. Pillars located in spaces intended for products which may produce explosive gases are to be of open section type.

4.1.4 Tight or non-tight bulkheads may be considered as pillars, provided that their arrangement complies with [5].

4.2 Connections

4.2.1 Heads and heels of pillars are to be attached to the surrounding structure by means of brackets or insert plates so that the loads are well distributed.

Insert plates may be replaced by doubling plates, except in the case of pillars which may also work under tension such as those in tanks.

In general, the net thickness of doubling plates is to be not less than 1,5 times the net thickness of the pillar.

4.2.2 Pillars are to be attached at their heads and heels by continuous welding.

4.2.3 Pillars are to be connected to the inner bottom at the intersection of girders and floors.

4.2.4 Where pillars connected to the inner bottom are not located in way of intersections of floors and girders, partial floors or girders or equivalent structures suitable to support the pillars are to be arranged.

4.2.5 Manholes may not be cut in the girders and floors below the heels of pillars.

4.2.6 Where pillars are fitted in tanks, head and heel brackets may be required if tensile stresses are expected.

4.2.7 Where side pillars are not fitted in way of hatch ends, vertical stiffeners of bulkheads supporting hatch side girders or hatch end beams are to be bracketed at their ends.

5 Bulkheads supporting beams

5.1 Scantlings

5.1.1 Partial or complete bulkheads may be substituted to pillars.

The scantlings of the vertical stiffeners of the bulkheads are to be such as to allow these stiffeners to offer the same compression and buckling strengths as a pillar, taking account of a strip of attached bulkhead plating, whose width is to be determined according to NR217, Pt B, Ch 2, Sec 6, [2.3].

Where a bulkhead supporting beams is part of the watertight subdivision of the unit or bounds a tank intended to contain liquids, its vertical stiffeners are to be fitted with head and heel brackets and their scantlings are to be increased to the satisfaction of the Society, taking account of the additional hydrostatic pressure.

SECTION 9 BULKHEAD STRUCTURE

1 General

1.1 Application

1.1.1 The requirements of this Section apply to longitudinal or transverse bulkhead structures.

1.1.2 Bulkheads may be plane or corrugated, horizontally or vertically stiffened.

Horizontally framed bulkheads consist of horizontal ordinary stiffeners supported by vertical primary supporting members.

Vertically framed bulkheads consist of vertical ordinary stiffeners which may be supported by horizontal girders.

1.2 Scantling

1.2.1 Minimum web net thickness of ordinary stiffeners

The scantlings of bulkhead structural members are to comply with Part B, Chapter 5.

1.3 General arrangement

1.3.1 The number and location of watertight bulkheads are to be in accordance with the relevant requirements given in Ch 2, Sec 1, [1].

1.3.2 Where an inner bottom terminates on a bulkhead, the lowest strake of the bulkhead forming the watertight floor of the double bottom is to extend at least 300 mm above the inner bottom.

1.3.3 Longitudinal bulkheads are to terminate at transverse bulkheads and are to be effectively tapered to the adjoining structure at the ends and adequately extended in the machinery space, where applicable.

1.3.4 The structural continuity of the bulkhead vertical and horizontal primary supporting members with the surrounding supporting structures is to be carefully ensured.

1.3.5 The height of vertical primary supporting members of longitudinal bulkheads may be gradually tapered from bottom to deck.

2 Plane bulkheads

2.1 General

2.1.1 Where a bulkhead does not extend up to the uppermost continuous deck, such as the after peak bulkhead, suitable strengthening is to be provided in the extension of the bulkhead.

2.1.2 Bulkheads are to be stiffened in way of deck girders.

2.1.3 The stiffener webs of side tank watertight bulkheads are generally to be aligned with the webs of inner hull longitudinal stiffeners.

2.1.4 Floors are to be fitted in the double bottom in way of plane transverse bulkheads.

2.1.5 Instead of the thickness increase required herebefore, a doubling plate of the same thickness as the bulkhead plating may be fitted.

2.2 Bulkhead stiffeners

2.2.1 As a rule, stiffeners are to be fitted in way of structural components likely to exert concentrated loads, such as deck girders and pillars, and for engine room end bulkheads, at the ends of the engine seatings.

On vertically framed watertight bulkheads, where stiffeners are interrupted in way of the watertight doors, stanchions are to be fitted on either side of the door, carlings are to be fitted to support the interrupted stiffeners.

2.3 End connections of ordinary stiffeners

2.3.1 In general, end connections of ordinary stiffeners are to be welded directly to the plating or bracketed. However, stiffeners may be sniped, provided the scantlings of such stiffeners are modified accordingly.

2.3.2 Sniped ends may be accepted where the hull lines make it mandatory in the following cases:

- liquid compartment boundaries
- end bulkheads.

2.3.3 Where sniped ordinary stiffeners are fitted, the snipe angle is to be not greater than 30° and their ends are to be extended, as far as practicable, to the boundary of the bulkhead.

Moreover, the thickness of the bulkhead plating supported by the stiffener is to be in compliance with Ch 2, Sec 5, [3.5.3].

2.4 Bracketed ordinary stiffeners

2.4.1 Where bracketed ordinary stiffeners are fitted, the arm lengths of end brackets of ordinary stiffeners, as shown in Fig 1 and Fig 2, are to be not less than the following values, in mm:

- for arm length a:
  - brackets of horizontal stiffeners and bottom bracket of vertical stiffeners:

    $a = 100\,\ell$
  - upper bracket of vertical stiffeners:

    $a = 80\,\ell$

- for arm length b, the greater of:

$$b = 80\sqrt{\frac{w+20}{t}}$$

$$b = \alpha\frac{ps\ell}{t}$$

where:

ℓ : Span, in m, of the stiffener measured between supports

w : Net section modulus, in cm^3, of the stiffener

t : Net thickness, in mm, of the bracket

p : Design pressure, in kN/m^2, calculated at mid-span

α : α = 4,9 for tank bulkheads

α = 3,6 for watertight bulkheads.

Figure 1 : Bracket at upper end of ordinary stiffener on plane bulkhead

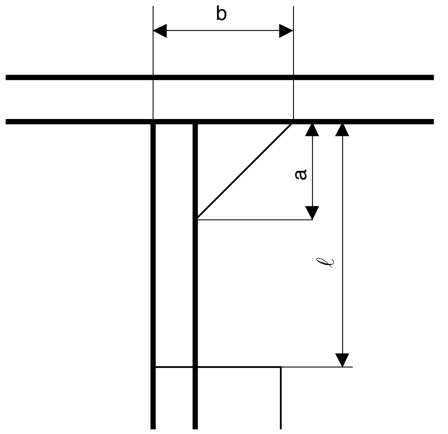
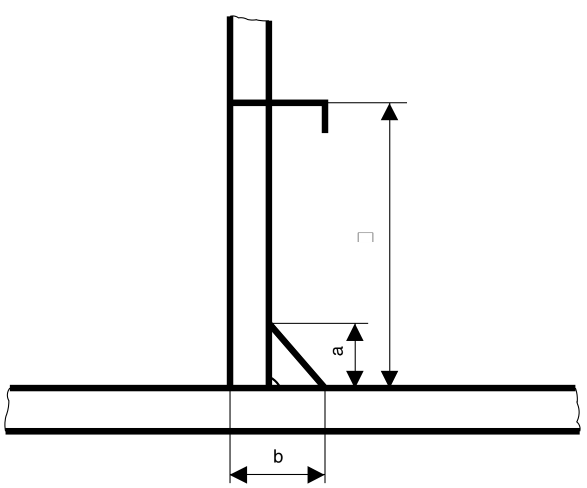


Figure 2 : Bracket at lower end of ordinary stiffener on plane bulkhead



2.4.2 The connection between the stiffener and the bracket is to be such that the section modulus of the connection is not less than that of the stiffener.

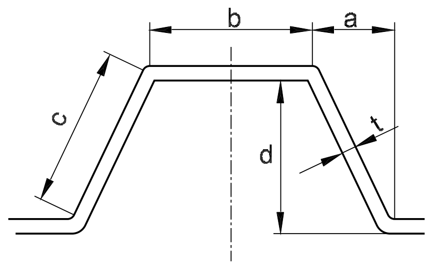
The brackets are to extend up to the next stiffener where the framing is transverse, or connect the stiffener to a longitudinal stiffener where the framing is longitudinal.

3 Corrugated bulkheads

3.1 General

3.1.1 The main dimensions a, b, c and d of corrugated bulkheads are defined in Fig 3.

Figure 3 : Corrugated bulkhead



3.1.2 Unless otherwise specified, the following requirement is to be complied with:

$a \leq d$

Moreover, in some cases, the Society may prescribe an upper limit for the ratio b/t.

3.1.3 In general, the bending internal radius R_i is to be not less than the following values, in mm:

- for normal strength steel:

  $R_i = 2,5\ t$

- for high tensile steel:

  $R_i = 3,0\ t$

where t, is the thickness, in mm, of the corrugated plate.

3.1.4 When butt welds in a direction parallel to the bend axis are provided in the zone of the bend, the welding procedures are to be submitted to the Society for approval, as a function of the importance of the structural element.

3.1.5 Transverse corrugated bulkheads having horizontal corrugations are to be fitted with vertical primary supporting members of number and size sufficient to ensure the required vertical stiffness of the bulkhead.

3.1.6 In general, where girders or vertical primary supporting members are fitted on corrugated bulkheads, they are to be arranged symmetrically.

3.2 Bulkhead scantlings

3.2.1 Bulkhead plating

The bulkhead plating net thickness is to be determined as specifies in Ch 5, Sec 1, substituting the stiffener spacing by the greater of the two values b and c, in m, as per [3.1.1].

3.2.2 Corrugations

The section modulus of a corrugation is to be not less than that of the equivalent stiffener having the same span as the corrugation and an attached plating width equal to (b + a).

The actual section modulus of a corrugation having the width (b + a) is to be obtained, in cm³, from following formula:

$$w = \frac{td}{6}(3b + c) \cdot 10^{-3}$$

where:

t : Net thickness of the plating of the corrugation, in mm

d, b, c : Dimensions of the corrugation, in mm, shown in Fig 3.

Moreover, where the ratio b / t ≥ 46, the net section modulus required for a bulkhead is to be in accordance with the following formula:

$$w = c_k(b + a)p\left(\frac{\ell b}{80t}\right)^2 10^{-3}$$

where:

c_k : Coefficient defined in Tab 1

p : Bulkhead design pressure, in kN/m², calculated at mid-span.

Table 1 : Values of coefficient c_k

Boundary conditions	End bulkheads	Watertight bulkhead	Cargo hold bulkhead
simply supported	1,73	1,38	1,04
simply supported (at one end)	1,53	1,20	0,92
clamped	1,15	0,92	0,69

3.2.3 Stringers and web frames

It is recommended to fit stringers or web frames symmetrically with respect to the bulkhead. In all cases, their section modulus is to be determined in the same way as for a plane bulkhead stringer or web frame.

3.3 Structural arrangement

3.3.1 The strength continuity of corrugated bulkheads is to be ensured at ends of corrugations.

3.3.2 Where corrugated bulkheads are cut in way of primary members, attention is to be paid to ensure correct alignment of corrugations on each side of the primary member.

3.3.3 In general, where vertically corrugated transverse bulkheads are welded on the inner bottom, floors are to be fitted in way of the flanges of corrugations.

However, other arrangements ensuring adequate structural continuity may be accepted by the Society.

3.3.4 Where stools are fitted at the lower part of transverse bulkheads, the thickness of adjacent plate floors is to be not less than that of the stool plating.

3.3.5 In general, where vertically corrugated longitudinal bulkheads are welded on the inner bottom, girders are to be fitted in double bottom in way of the flanges of corrugations.

However, other arrangements ensuring adequate structural continuity may be accepted by the Society.

3.3.6 In general, the upper and lower parts of horizontally corrugated bulkheads are to be flat over a depth equal to 0,1 D.

3.4 Bulkhead stool

3.4.1 In general, plate diaphragms or web frames are to be fitted in bottom stools in way of the double bottom longitudinal girders or plate floors, as the case may be.

3.4.2 Brackets or deep webs are to be fitted to connect the upper stool to the deck transverses or hatch end beams, as the case may be.

3.4.3 The continuity of the corrugated bulkhead with the stool plating is to be adequately ensured. In particular, the upper strake of the lower stool is to be of the same thickness and yield stress as those of the lower strake of the bulkhead.

4 Non-watertight bulkheads

4.1 Non-watertight bulkheads

4.1.1 Definition

A bulkhead is considered to be acting as a pillar when besides the lateral loads, axial loads are added.

4.1.2 Non-watertight bulkheads not acting as pillars

Non-tight bulkheads not acting as pillars are to be provided with vertical stiffeners with a maximum spacing equal to:

- 0,9 m, for transverse bulkheads
- two frame spacings with a maximum of 1,5 m, for longitudinal bulkheads.

4.1.3 Non-watertight bulkheads acting as pillars

Non-tight bulkheads acting as pillars are to be provided with vertical stiffeners with a maximum spacing equal to:

- two frame spacings, when the frame spacing does not exceed 0,75 m
- one frame spacing, when the frame spacing is greater than 0,75 m.

Each vertical stiffener, in association with a width of plating equal to 35 times the plating thickness, is to comply with the applicable requirements for pillars in Ch 5, Sec 4, [3.1], the load supported being determined in accordance with the same requirements.

In the case of non-tight bulkheads supporting longitudinally framed decks, web frames are to be provided in way of deck transverses.

Part B
Hull and Stability

Chapter 3
DESIGN LOADS

SECTION 1 GENERAL

Symbols

M_H : Design still water bending moment in hogging condition, in kN.m

M_S : Design still water bending moment in sagging condition, in kN.m

M_{TH} : Total vertical bending moment in hogging condition, in kN.m

M_{TS} : Total vertical bending moment in sagging condition, in kN.m

M_W : Additional bending moment, in kN.m

p : Design pressure, in kN/m^2

x, y, z : X, Y and Z co-ordinates, in m, of the calculation point with respect to the reference co-ordinate system defined in Ch 1, Sec 2, [2.1]

z_{TOP} : Z co-ordinate, in m, of the highest point of the tank or compartment

z_{AP} : Z co-ordinate, in m, of the top of air pipe

d_{AP} : Distance from the top of the air pipe to the top of the tank, in m

p_{pv} : Setting pressure, in kN/m^2, of safety valves or maximum pressure, in kN/m^2, in the tank, whichever is the greatest

ρ_L : Density, in t/m^3, of the liquid carried

γ : Loading coefficient defined in Tab 1

T_1 : Draught associated with each loading condition, (see also Fig 1).

Where the value of T_1 is not provided, it may be taken equal to:

$T_1 = \gamma T$

with γ defined in Tab 1.

1 General

1.1 Standard loading conditions

1.1.1 Lightship

The light standard loading conditions are:

- supplies: 100%
- ballast: 50%.

1.1.2 Fully loaded unit

The unit is considered to be homogeneously loaded at its maximum draught with:

- maximum permitted number of persons onboard
- supplies: 100%
- ballast: empty.

1.2 Load cases

1.2.1 General

The mutually exclusive load cases described in [1.2.2] and [1.2.3] are those to be used for the following structural element analyses:

- analyses of plating
- analyses of ordinary stiffeners
- analyses of primary supporting members analysed through isolated beam structural models or three dimensional structural models.

1.2.2 Upright unit condition

The unit is considered in upright operation condition and is subjected to:

- external pressure: hydrostatic river pressure.
- internal loads induced by the weights carried
- hull girder loads: vertical bending moment and shear force.

1.2.3 Inclined unit condition

The inclined unit condition is only to be taken into account for local strength check, namely for the racking analysis.

Figure 1 : River still water pressure

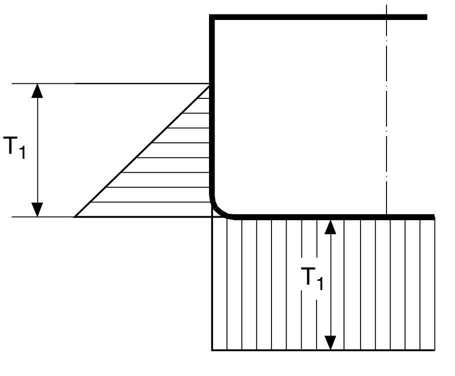


Table 1 : Values of loading coefficient γ

Loading condition	γ	
	River counter pressure	River design pressure
Full load	1,000	1,000
Lightship	0,150	0,150

SECTION 2 HULL GIRDER LOADS

1 General

1.1 Design still water bending moments

1.1.1 The values of design still water bending moments, M_H and M_S, are to be provided by the designer, for all load cases considered.

All calculation documents are to be submitted to the Society.

1.2 Additional bending moment

1.2.1 The additional bending moment taking into account the stream and water conditions in the operation zone is to be considered.

The absolute value of the additional bending moment amidships is to be obtained, in kN.m, from the following formula:

$M_W = 0,045\ L^2\ B\ C_B$

1.3 Total vertical bending moments

1.3.1 The total vertical bending moments are to be determined as follows:

- $M_{TH} = M_H + M_W$
- $M_{TS} = M_S + M_W$

1.4 Design still water vertical shear force

1.4.1 The value of the design still water vertical shear force, T_S , is to be provided by the designer.

1.5 Additional vertical shear force

1.5.1 The value of the additional vertical shear force, in kN, is to be obtained from the following formula:

$T_W = 0,14 L B C_B$

1.6 Total vertical shear force

1.6.1 The total vertical shear force is to be determined as follows:

$T = T_S + T_W$.

SECTION 3 LOCAL LOADS

1 General

1.1 Application

1.1.1 The requirements of this Section apply for the definition of local loads to be used for the scantling checks of:

- platings
- ordinary stiffeners
- primary supporting members.

1.2 External pressure on sides and bottom

1.2.1 River design pressure

The river design pressure p_E at any point of the hull, in kN/m^2, is given by the formulae:

- for $z \le T_1$: $p_E = p_{SE} + p_{WE}$
- for $z > T_1$: $p_E = p_{WE}$

where:

p_{SE} : River still water pressure, in kN/m^2, defined in [1.2.3]

p_{WE} : River additional pressure, in kN/m^2, defined in [1.2.4].

1.2.2 River counter pressure

The river counter pressure p_{Em} at any point of the hull, in kN/m^2, is given by the formulae:

- for $z \le T_1$: $p_{Em} = p_{SE} + p_{WE}$
- for $z > T_1$: $p_{Em} = p_{WE}$

where:

p_{SE} : River still water pressure, in kN/m^2, defined in [1.2.3]

p_{WE} : River additional pressure, in kN/m^2, defined in [1.2.4].

1.2.3 River still water pressure

The river still water pressure at any point of the hull, in kN/m^2, is given by the formula:

$p_{SE} = 9,81\ (T_1 - z)$

1.2.4 River additional pressure

The river additional pressure p_{WE} at any point of the hull, in kN/m^2, is to be obtained from formulae given in Tab 1.

1.3 External pressure on exposed decks

1.3.1 The pressure p_E on exposed decks is not to be taken less than the values given in Tab 2.

1.4 Internal liquid load

1.4.1 Still water pressure

The still water pressure p_S transmitted to the hull structure, in kN/m^2, by carried liquids (ballast p_B or supplies p_C) is the maximum of the values obtained from the following formulae

- $p_S = 9,81 \rho_L\ (z_{TOP} - z) + 1,15\ p_{pv}$
- $p_S = 9,81\ \rho_L (z_{TOP} - z + d_{AP})$

1.5 Dry uniform loads

1.5.1 Design pressure

The design pressure p_C, in kN/m^2, is to be defined by the Designer.

1.6 Dry unit loads

1.6.1 Still water force

The still water force F_S transmitted to the hull structure is to be determined on the basis of the force obtained, in kN, from the following formula:

$F_S = 9,81\ m_C$

where m_C is the mass, in t, of the dry unit load.

Account is to be taken of the elastic characteristics of the lashing arrangement and/or the structure which supports the load.

Table 1 : River wave pressure on sides and bottom in upright condition

Location	River additional pressure p_{WE}, in kN/m^2, to be used for:	
	Calculation of river design pressure p_E	Calculation of river counter pressure p_{Em}
Bottom and sides below the waterline ($z \le T_1$)	$p_{WE} = 2,94\left(\frac{0,23(z - T_1)}{T_1} + 1\right)$	$p_{WE} = -2,94\left(\frac{0,23(z - T_1)}{T_1} + 1\right)$ without being taken less than $-9,81\ (T_1 - z)$
Sides above the waterline ($z > T_1$)	$p_{WE} = 9,81\ (T_1 - z + 0,3)$ without being taken less than 2	0,0

Table 2 : Pressure p_E on exposed decks

Exposed deck location	p_E, in kN/m²
Weather deck	3,75 (n + 0,8)
Exposed deck of superstructure or deckhouse:	
• First tier (non public)	2,0
• Upper tiers (non public)	1,5
• Public	4,0

1.7 Wheeled loads

1.7.1 Tyred vehicles

The forces transmitted through the tyres are considered as pressure uniformly distributed on the tyre print, whose dimensions are to be indicated by the designer together with information concerning the arrangement of wheels on axles, the load per axle and the tyre pressures.

With the exception of dimensioning of plating, such forces may be considered as concentrated in the tyre print centre.

1.7.2 Non-tyred vehicles

The requirements of [1.7.3] also apply to tracked vehicles; in this case the print to be considered is that below each wheel or wheelwork.

For vehicles on rails, all the forces transmitted are to be considered as concentrated at the contact area centre.

1.7.3 Still water force

The still water force F_S transmitted to the hull structure by one wheel is to be determined on the basis of the force obtained, in kN, from the formula:

$F_s = 9,81\ m_C$

where:

$m_C = Q_A / n_w$

Q_A : Axle load, in t. For fork-lift trucks, the value of Q_A is to be taken equal to the total mass of the vehicle, including that of the load handled, applied to one axle only

n_w : Number of wheels for the axle considered.

1.8 Accommodation

1.8.1 Still water pressure

The still water pressure p_S, in kN/m², transmitted to the deck structure is to be defined by the designer and, in general, is not to be taken less than values given in Tab 3.

Table 3 : Minimum deck still water pressure p_S in accommodation compartments

Type of accommodation compartment	p_S, in kN/m²
• Large spaces (such as: restaurants, halls, cinemas, lounges, kitchen, service spaces, games and hobbies rooms, hospitals)	4,0
• Bedrooms	3,0
• Other compartments	2,5

1.9 Helicopter loads

1.9.1 Landing load

The landing load F_{CR} transmitted through one tyre to the deck is to be obtained, in kN, from the following formula:

$F_{CR} = 7,36\ W_H$

where W_H is the maximum weight of the helicopter, in t.

Where the upper deck of a superstructure is used as a helicopter deck and the spaces below are quarters, control room or other normally manned service spaces, the value of F_{CR} is to be multiplied by 1,15.

1.9.2 Emergency landing load

The emergency load resulting from the crash of the helicopter is to be obtained, in kN, from the following formula:

$F_{CR} = 29,43\ W_H$

1.9.3 Helicopter having landing devices other than wheels

In the case of a deck intended for the landing of helicopters having landing devices other than wheels (e.g. skates), the landing load and the emergency landing load are to be examined by the Society on a case by case basis.

2 Flooding pressure

2.1 Still water pressure

2.1.1 The still water pressure p_{FL} to be considered as acting on platings and stiffeners of watertight bulkheads of compartments not intended to contain liquids is obtained, in kN/m², from the following formula:

$p_{FL} = 9,81\ (z_{TOP} - z)$

3 Testing pressures

3.1 Still water pressures

3.1.1 The still water pressures p_{ST} to be considered as acting on plates and stiffeners subject to tank testing are specified in Tab 4.

Table 4 : Testing - Still water pressures

Compartment or structure to be tested	Still water pressure p_{ST}, in kN/m²
Double bottom tanks	$p_{ST} = 9,81\ [(z_{TOP} - z) + d_{AP}]$
Double side tanks Peaks used as tanks	The greater of the following: $p_{ST} = 9,81\ [(z_{TOP} - z) + d_{AP}]$ $p_{ST} = 9,81\ [(z_{TOP} - z) + 1]$
Ballast compartments Fuel oil bunkers Cofferdams	The greater of the following: $p_{ST} = 9,81\ [(z_{TOP} - z) + d_{AP}]$ $p_{ST} = 9,81\ [(z_{TOP} - z) + 1]$
Double bottom Peaks not used as tank	$p_{ST} = 9,81\ (z_{AP} - z)$
Other independent tanks	$p_{ST} = 9,81\ [(z_{TOP} - z) + d_{AP}]$

Part B
Hull and Stability

Chapter 4
HULL GIRDER STRENGTH

SECTION 1 STRENGTH CHARACTERISTICS OF THE HULL GIRDER TRANSVERSE SECTIONS

Symbols

Z : Net hull girder section modulus, in cm^3

M_{TH} : Total vertical bending moment in hogging condition, in kN.m, to be determined according to Ch 3, Sec 2, [1.3]

M_{TS} : Total vertical bending moment in sagging condition, in kN.m, to be determined according to Ch 3, Sec 2, [1.3]

k : Material factor defined in Ch 2, Sec 3, [2.4], and Ch 2, Sec 3, [3.4].

1 General

1.1 Application

1.1.1 This Section specifies the criteria for calculating the hull girder strength characteristics to be used for the checks, in association with the hull girder loads.

2 Characteristics of the hull girder transverse sections

2.1 Hull girder transverse sections

2.1.1 General

The hull girder transverse sections are to be considered as being constituted by the members contributing to the hull girder longitudinal strength, i.e. all continuous longitudinal members below the strength deck defined in [3.1], taking into account the requirements of [2.1.2] to [2.1.5].

2.1.2 Longitudinal bulkheads with vertical corrugations

Longitudinal bulkheads with vertical corrugations may not be included in the hull girder transverse sections.

2.1.3 Members in materials other than steel

Where a member is made in material other than steel, its contribution to the longitudinal strength will be determined by the Society on case by case basis.

2.1.4 Large openings and scallops

Large openings are:

- in the side shell plating: openings having a diameter greater than or equal to 300 mm
- in the strength deck: openings having a diameter greater than or equal to 350 mm.

Large openings and scallops, where scallop welding is applied, are always to be deducted from the sectional areas included in the hull girder transverse sections.

2.1.5 Lightening holes, draining holes and single scallops

Lightening holes, draining holes and single scallops in longitudinals or girders need not be deducted if their height is less than 0,25 h_W, without being greater than 75 mm, where h_W is the web height, in mm.

Otherwise, the excess is to be deducted from the sectional area or compensated.

2.2 Hull girder section modulus

2.2.1 The section modulus at any point of a hull transverse section is obtained, in cm^3, from the following formula:

$$Z = \frac{I_Y}{100|z - N|}$$

where:

I_Y : Moment of inertia, in cm^4, of the hull girder transverse section defined in [2.1], about its horizontal neutral axis

N : Z co-ordinate, in m, of the centre of gravity of the hull transverse section

z : Z co-ordinate, in m, of the calculation point of a structural element.

3 Contribution to longitudinal strength

3.1 Strength deck

3.1.1 The strength deck is, in general, the uppermost continuous deck.

3.2 Contribution of erections

3.2.1 General

Superstructures are deck erections defined in Ch 1, Sec 2, [1.7].

The stress distribution within an erection will depend on such factors as the end conditions of the erection, the rigidity of the support structure, the size and location of major openings in the sides of the erection, the location and alignment of support bulkheads and webs within the erection, etc.

An erection is considered as rigidly constrained to act with the main hull girder if:

- its side plating is a continuation of the main hull side shell, or
- where its sides are placed at some distance inboard of the shell or deck edge, bulkheads or other internal vertical structure for tie-in with the main hull are fitted.

3.2.2 Bending efficiency

The bending efficiency indicating the contribution degree of an erection to the hull girder strength may be defined as the ratio of actual stress at the erection neutral axis, σ_1' to the hull girder stress at the same point σ_1, computed as if the hull and the erection behaved as a single beam:

$$\nu = \frac{\sigma_1'}{\sigma_1}$$

The efficiency ν_i of a superstructure i, rigidly constrained to act with the main hull girder, may be determined using the formula:

$\nu_i = \nu_{i-1}\,(0{,}37\,\chi - 0{,}034\,\chi^2)$

where:

ν_{i-1} : Bending efficiency of superstructure located below considered erection

χ : Dimensionless coefficient defined as:

$\chi = 100\, j\, \lambda \le 5$

λ : Erection half length, in m

j : Parameter, in cm^{-1}, defined as:

$$j = \sqrt{\frac{1}{\frac{1}{A_{SH1}} + \frac{1}{A_{SHe}}} \cdot \frac{\Omega}{2,6}}$$

A_{SH1}, A_{SHe}: Independent vertical shear areas, in cm^2, of hull and erection, respectively

Ω : Parameter, in cm^{-4}, defined as:

$$\Omega = \frac{(A_1 + A_e)(I_1 + I_e) + A_1 A_e (e_1 + e_e)^2}{(A_1 + A_e) I_1 I_e + A_1 A_e (I_1 e^2_e + I_e e^2_1)}$$

A_1, A_e : Independent sectional areas, in cm^2, of hull and erection, respectively, determined in compliance with [2]

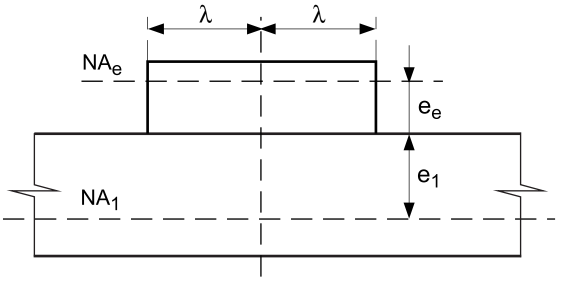
I_1, I_e : Independent section moments of inertia, in cm^4, of hull and erection, respectively, determined in compliance with [2], about their respective neutral axes

e_1, e_e : Vertical distances, in cm, from the main (upper) deck down to the neutral axis of the hull and up to the neutral axis of the erection respectively (see Fig 1).

An erection with large side entrances is to be split into sub-erections. The formulas given hereabove are, therefore, to be applied to each individual sub-erection.

If the erection material differs from that of the hull, the geometric area A_e and the moment of inertia I_e must be reduced according to the ratio E_e/E_1 of the respective material Young moduli.

Figure 1 : Parameters determining the superstructure efficiency



SECTION 2 YIELDING CHECK

1 General

1.1 Stress calculation

1.1.1 The hull girder normal stresses induced by vertical bending moments are obtained, in N/mm², from the following formulae:

- in hogging conditions:

$$\sigma_1 = \frac{M_{TH}}{Z} 10^3$$

- in sagging conditions:

$$\sigma_1 = \frac{M_{TS}}{Z} 10^3$$

1.2 Checking criterion

1.2.1 It is to be checked that the normal hull girder stresses, in N/mm², at any point of the net hull girder transverse section, calculated according to [1.1.1] are in compliance with the following:

$\sigma_1 \leq 192 / k$

Part B
Hull and Stability

Chapter 5
HULL SCANTLINGS

SECTION 1 GENERAL

Symbols

t : Net thickness, in mm, of plating

s : Spacing, in m, of ordinary stiffeners

S : Spacing, in m, of primary supporting members

ℓ : Span, in m, of ordinary stiffeners or primary supporting members defined in Ch 2, Sec 5, [3.2] or Ch 2, Sec 5, [4.1]

η : Coefficient taken equal to:

$\eta = 1 - s / 2\ell$

p : Design lateral pressure, in kN/m², defined in Ch 5, Sec 2, [3.1]

p_E : External pressure, in kN/m², defined in Ch 3, Sec 3, [1.2] and Ch 3, Sec 3, [1.3]

p_{Em} : River counterpressure, in kN/m², defined in Ch 3, Sec 3, [1.2]

p_{ST} : Test pressure, in kN/m², defined in Ch 3, Sec 3, [3]

p_{FL} : Design pressure in flooding condition, in kN/m², defined in Ch 3, Sec 3, [2]

p_B : Ballast pressure, in kN/m², defined in Ch 3, Sec 3, [1.4]

p_C : Internal pressure (other than ballast pressure), in kN/m², defined from Ch 3, Sec 3, [1.4] to Ch 3, Sec 3, [1.7]

σ_{X1} : Hull girder normal stress, in N/mm², defined in Ch 5, Sec 2, Ch 5, Sec 3 and Ch 5, Sec 4

w : Net section modulus, in cm³, of ordinary stiffeners or primary supporting members

A_{sh} : Net shear sectional area, in cm²

k : Material factor defined in Ch 2, Sec 3, [2.4] and Ch 2, Sec 3, [3.4]

k_0 : Young's modulus factor, to be taken equal to

- for steels, in general:

  $k_0 = 1,00$

- for stainless steels:

  $k_0 = 0,97$

- for aluminium alloys:

  $k_0 = 0,58$

z : Z co-ordinate, in m, of the calculation point

N : Z co-ordinate, in m, of the centre of gravity of the hull transverse section

Z : Net hull girder section modulus, in cm³.

C_a : Aspect ratio, equal to:

$$c_a = 1,21\sqrt{1 + 0,33\left(\frac{s}{\ell}\right)^2} - 0,69\frac{s}{\ell} \le 1$$

C_r : Coefficient of curvature:

$$c_r = 1 - 0,5\frac{s}{r} \ge 0,75$$

where:

r : Radius of curvature, in m

M_{TH} : Total vertical bending moment in hogging condition, in kN.m, to be determined according to Ch 3, Sec 2, [1.3]

M_{TS} : Total vertical bending moment in sagging condition, in kN.m, to be determined according to Ch 3, Sec 2, [1.3]

I_Y : Net moment of inertia, in cm⁴, of the hull transverse section around its horizontal neutral axis, to be calculated according to Ch 4, Sec 1, [3]

N : Z co-ordinate, in m, of the centre of gravity of the hull transverse section

α : Aspect ratio defined in Ch 5, Sec 2, [4.1.2]

b : Length, in m, of loaded side of the plate panel

ψ : Edge stress ratio defined in Ch 5, Sec 2, [4.1.3]

F_1 : Correction factor defined in Ch 5, Sec 2, [4.1.4]

K_1 : Factor defined in Ch 5, Sec 2, [4.1.5]

R_{eH} : Minimum yield stress, in N/mm², defined in Ch 2, Sec 3, [2.1].

1 General

1.1 Application

1.1.1 This Chapter contains the requirements for the arrangement and the determination of the hull scantlings of all floating establishments complying with Ch 1, Sec 1, [1.1.1].

1.1.2 Units with L/D > 35

When the ratio L/D of the unit exceeds 35, a proof is to be furnished showing that the following condition on the hull girder deflection, f, is satisfied:

$$f \le 0,001\,L$$

1.1.3 Units with L/B < 8

When the ratio L/B of the unit is less than 8, a proof of sufficient transverse hull girder strength is to be furnished by following a process similar to that given in [1.1.2], for longitudinal strength.

Moreover, the scantling of transverse structural members contributing to the transverse overall strength, is to be performed taking into account the transverse normal hull girder stresses.

1.2 Resistance partial safety factors

1.2.1 The values of partial safety factors covering uncertainties on resistance to be considered for checking structural members are specified in Tab 1

Table 1 : Resistance partial safety factor γ_R

Item	Yielding		
	Centre part	End parts	Super-structure
Plating	1,20 1,05 **(1)**	1,20 1,05 **(1)**	1,20
Ordinary stiffeners	1,02	1,40 1,20 **(1)**	1,02
Primary supporting members **(3)**	1,02 1,15 **(2)**	1,60 1,40 **(1)**	1,02

(1) Testing conditions
(2) Bottom and side girders
(3) Analysed through isolated beam models

SECTION 2 PLATING

1 General

1.1 Elementary plate panel

1.1.1 The elementary plate panel is the smallest unstiffened part of plating.

1.2 Load point

1.2.1 Unless otherwise specified, lateral pressure and hull girder stresses are to be calculated:

- for longitudinal framing, at the lower edge of the elementary plate panel or, in the case of horizontal plating, at the point of minimum y-value among those of the elementary plate panel considered
- for transverse framing, at the lower edge of the strake.

2 General requirements

2.1 General

2.1.1 The requirements of this Sub-article are to be applied to plating in addition of those in [3.1] to [4.1].

2.2 Minimum net thickness

2.2.1 The net thickness of plating is to be not less than the values given in Tab 1.

Table 1 : Minimum net thickness of plating (in mm)

Plating	Minimum net thickness
Bottom	
• longitudinal framing	$1,1 + 0,03\ L\ k^{1/2} + 3,6\ s$
• transverse framing	$1,85 + 0,03\ L\ k^{1/2} + 3,6\ s$
Inner bottom	$1,5 + 0,024\ L\ k^{1/2} + 4,5\ s$
Side	
• longitudinal framing	$1,25 + 0,02\ L\ k^{1/2} + 3,6\ s$
• transverse framing	$1,68 + 0,025\ L\ k^{1/2} + 3,6\ s$
Sheerstrake	
• inserted strake	$3,6 + 0,11\ L\ k^{1/2} + 3,6\ s$
• doubling strake	$2,6 + 0,076\ L\ k^{1/2} + 3,6\ s$
Inner side Longitudinal bulkhead	$2 + 0,003\ L\ k^{1/2} + 3,6\ s$
Strength deck	
• longitudinal framing	$0,57 + 0,031\ L\ k^{1/2} + 3,6\ s$
• transverse framing	$0,9 + 0,034\ L\ k^{1/2} + 3,6\ s$
Transv. watertight bulkhead	$0,026\ L\ k^{1/2} + 3,6\ s$
Transom	$1,68 + 0,025\ L\ k^{1/2} + 3,6\ s$

2.3 Keel

2.3.1 Units having a rise of floor are to be fitted with a keel plate of about 0,1 B in width, with a thickness equal to 1,15 times the bottom plating thickness.

In the case there is no rise of floor, the keel plate thickness is to be not less than the bottom plating thickness.

2.4 Bilge scantling

2.4.1 Radius

Where the bilge plating is rounded, the radius of curvature is not to be less than 20 times the thickness of the plating.

2.4.2 Extension of rounded bilge

The bilge is to extend at least 100 mm on either side of the rounded part.

2.4.3 Scantling of rounded bilge

The bilge plating net thickness, in mm, is to be not less than the following values:

- in the case of a bilge radius of curvature practically equal to the floor depth or bottom transverse depth:

  $t = 1,15\ t_0$

- in the case of a bilge radius of curvature less than the floor depth or bottom transverse depth but greater than 20 times the bottom plating thickness:

  $t = 1,15\ t_0 + 1$

where:

t_0 : Adjacent bottom plating rule thickness.

2.4.4 Scantling of square bilge

In the case of a square bilge with chine bars (sketches a, b, c and e of Fig 1), the net scantling of the chine bar is to be determined as follows:

- angle bars

  The net thickness of the bars plating, in mm, is to be not less than the following formulas, where t_0 is the rule bottom plating net thickness:

  - angle bars inside the hull: $t = t_0 + 2$
  - other cases: $t = t_0 + 3$

- round bars and square bars

  The diameter of the round bars or the side of the square bars is to be not less than 30 mm.

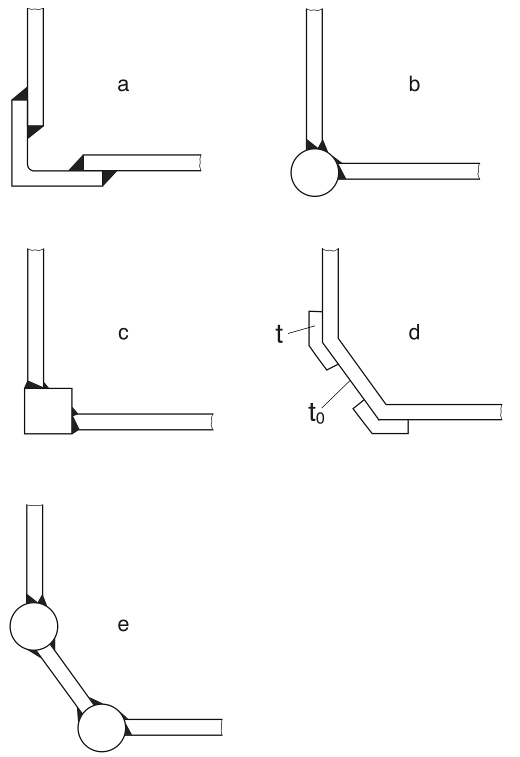
In the case of a double chine without chine bars (sketch d of Fig 1), the thickness of the doublers, in mm, is to be not less than:

$t = t_0 + 3$

where:

t_0 : Adjacent bottom plating thickness.

Figure 1 : Square bilge



2.5 Sheerstrake

2.5.1 General

The sheerstrake may be either an inserted side strake welded to the stringer plate or a doubling plate.

2.5.2 The sheerstrake net thickness is not to be less than that of the stringer plate nor than that of the side shell plating.

2.5.3 Rounded sheerstrake

In the case of a rounded sheerstrake connecting the side shell to the deck, the radius of curvature of the strake, in mm, is not to be less than 5 times its thickness.

2.5.4 Width

Where the sheerstrake thickness is greater than that of the adjacent side shell plating, the sheerstrake is to extend over a height b, measured from the deckline, in compliance with the following relation:

$0,08\ D \le b \le 0,15\ D$

Where a sheerstrake does not rise above deck, a footguard angle or flat is to be fitted at about 100 mm from the side shell.

The height of the sheerstrake / footguard above the deck is to be at least 50 mm.

2.6 Stringer plate

2.6.1 Width

Where the stringer plate has a thickness greater than that of the deck plating, its width is to be not less than 50 times its thickness.

2.6.2 Stringer angle

Where a stringer angle is fitted, its thickness is not to be less than that of the side shell plating increased by 1 mm nor, as a rule, when the vessel is built on the transverse system, than that of the stringer plate.

2.6.3 If the stringer plate is rounded at side, it is to extend on the side shell plating over a length at least equal to 25 times its thickness, for units built on the transverse system.

3 Strength check of plating subjected to lateral pressure

3.1 Load model

3.1.1 Design lateral pressure in service conditions

The design lateral pressure, p, in service conditions to be used for hull scantling is defined in Tab 2.

3.1.2 Design lateral pressure in testing conditions

The design lateral pressure, p, in testing conditions is taken equal to:

- $p_{ST} - p_S$ for bottom shell plating and side shell plating
- p_{ST} otherwise,

where p_S is the still water river pressure defined in Ch 3, Sec 3, [1.2] for the draught T_1 at which the testing is carried out.

If the draught T_1 is not defined by the Designer, it may be taken equal to 0,15T.

3.1.3 Design lateral pressure in flooding conditions

The design lateral pressure, p, in flooding conditions to be used for hull scantling is defined in Tab 2.

Table 2 : Design lateral pressure, p, in kN/m²

Structure	In service conditions	In testing conditions	In flooding conditions
Shell structure	• p_E • $p_C - p_{Em}$ • $p_B - p_{Em}$	• p_{ST} • $p_{ST} - p_S$ **(1)**	-
Deck structure	• p_E • p_C • p_B	p_{ST}	-
Internal structure	• p_C • p_B	p_{ST}	p_{FL}
(1) Testing afloat			

3.1.4 Hull girder normal stresses

The hull girder normal stresses to be considered for the strength check of plating subjected to lateral pressure are to be determined using the formula:

$$\sigma_{X1} = 10^5 \left| \frac{\max(M_{TH};M_{TS})}{I_Y}(z - N) \right|$$

Table 3 : Net thickness of plating subjected to lateral pressure, in mm

Conditions	Transverse framing	Longitudinal framing
Service and flooding	$t = 1{,}13 C_a C_r s \sqrt{\dfrac{k \gamma_R p}{\lambda_T}}$	$t = 0{,}98 C_a C_r s \sqrt{\dfrac{k \gamma_R p}{\lambda_L}}$
Testing	$t = 0{,}98 C_a C_r s \sqrt{k \gamma_R p}$	
• For plating contributing to hull girder strength $\lambda_T = 1 - 0{,}0038 \sigma_{x1}$ $\lambda_L = \sqrt{1 - 1{,}78 \cdot 10^{-5} \sigma_{x1}^2} - 10^{-3} \sigma_{x1}$ • For plating not contributing to hull girder strength $\lambda_T = \lambda_L = 1$		

3.2 Net thickness of plating subjected to lateral pressure

3.2.1 The net thickness of plating subjected to lateral pressure is to be not less than the values obtained, in mm, from the formulae given in Tab 3.

4 Buckling strength check

4.1 General

4.1.1 Application

The requirements of this Sub-article apply for the buckling check of plating subjected to in-plane compression stresses, acting on one or two sides.

Rectangular plate panels are considered as being simply supported. For specific designs, other boundary conditions may be considered, at the Society's discretion, provided that the necessary information is submitted for review/approval.

4.1.2 Aspect ratio

The aspect ratio α of elementary plate panel is to be taken equal to:

$\alpha = a / b$

where:

a : Length, in m, of not loaded side of the plate panel

b : Length, in m, of loaded side of the plate panel.

4.1.3 Edge stress ratio

The edge stress ratio ψ is to be taken equal to:

$\psi = \sigma_2 / \sigma_1$

where:

σ_1 : Maximum compressive stress

σ_2 : Minimum compressive stress or tensile stress.

Table 4 : Factor K_1 for plane panels

Load pattern	Aspect ratio	Factor K_1
$0 \le \psi \le 1$	$\alpha \ge 1$	$\dfrac{8{,}4}{\psi + 1{,}1}$
	$\alpha < 1$	$\left(\alpha + \dfrac{1}{\alpha}\right)^2 \dfrac{2{,}1}{\psi + 1{,}1}$
$-1 < \psi < 0$		$(1 + \psi) K_1' - \psi K_1'' + 10 \psi (1 + \psi)$
$\psi \le -1$	$\alpha \dfrac{1 - \psi}{2} \ge \dfrac{2}{3}$	$23{,}9 \left(\dfrac{1 - \psi}{2}\right)^2$
	$\alpha \dfrac{1 - \psi}{2} < \dfrac{2}{3}$	$\left(15{,}87 + \dfrac{1{,}87}{\left(\alpha \dfrac{1 - \psi}{2}\right)^2} + 8{,}6 \left(\alpha \dfrac{1 - \psi}{2}\right)^2\right) \left(\dfrac{1 - \psi}{2}\right)^2$
Note 1: K_1' : Value of K_1 calculated for $\psi = 0$ K_1'' : Value of K_1 calculated for $\psi = -1$		

4.1.4 Correction factor for boundary conditions

The correction factor, F_1, for boundary conditions is to be taken equal to:

- $F_1 = 1,00$ for $\alpha \geq 1$
- $F_1 = 1,05$ for $\alpha < 1$ and loaded side stiffened by flat bar
- $F_1 = 1,10$ for $\alpha < 1$ and loaded side stiffened by bulb section
- $F_1 = 1,21$ for $\alpha < 1$ and loaded side stiffened by angle or T-section
- $F_1 = 1,30$ for $\alpha < 1$ and loaded side stiffened by primary supporting members.

4.1.5 Factor K_1

The factor K_1 to be used for the calculation of thickness t_3 is given in Tab 4.

4.2 Load model

4.2.1 Hull girder normal compression stresses

The hull girder normal compression stresses to be considered for the buckling strength check of the plating and structural members which contribute to the longitudinal strength are given in Tab 5.

Table 5 : Hull girder normal compression stresses

Condition	σ_{X1}, in N/mm²
$z \geq N$	$\sigma_{X1} = 10^5 \left\lvert \frac{M_{TS}}{I_Y}(z-N) \right\rvert$
$z < N$	$\sigma_{X1} = 10^5 \left\lvert \frac{M_{TH}}{I_Y}(z-N) \right\rvert$

4.3 Net thickness of plating complying with the buckling criteria

4.3.1 The net thicknesses of plating subjected to in-plane compression normal hull girder stresses, in mm, are to comply with the following formulae:

$$t = 2,45b\sqrt{\frac{\sigma_b}{k_0 K_1 F_1}} \quad \text{for} \quad \sigma_b \leq \frac{R_{eH}}{2}$$

$$t = 1,158b\sqrt{\frac{R_{eH}^2}{k_0 K_1 F_1 (R_{eH} - 1,12\sigma_b)}} \quad \text{for} \quad \sigma_b > \frac{R_{eH}}{2}$$

where:

σ_b : maximum hull girder compression stress on the plate panel determined according to [4.2.1].

Buckling strength may be checked in compliance with NR217, Pt B, Ch 2, Sec 6, at the Society's discretion.

SECTION 3 ORDINARY STIFFENERS

1 General

1.1 Load point for lateral pressure

1.1.1 Unless otherwise specified, lateral pressure is to be calculated at mid-span of the ordinary stiffener considered.

1.2 Load point for hull girder stresses

1.2.1 For longitudinal ordinary stiffeners contributing to the hull girder longitudinal strength, the hull girder normal stresses are to be calculated in way of the attached plating of the stiffener considered.

1.3 Span correction coefficients

1.3.1 These Rules apply to ordinary stiffeners without end brackets, with a bracket at one end or with two equal end brackets.

The span correction coefficients β_b and β_s, of ordinary stiffeners are to be determined using the following formulae:

$$\beta_b = \left(1 - \sum_{i=1}^{n} \frac{\ell_{bi}}{\ell}\right)^2$$

$$\beta_s = \left(1 - \sum_{i=1}^{n} \frac{\ell_{bi}}{\ell}\right)$$

where:

ℓ : Span, in m, of ordinary stiffener, defined in Ch 2, Sec 5, [3.2]

$\ell_{bi} = 0,5\ \ell_b$

$\ell_b = MIN\ (d\ ;\ b)$

d, b : Length, in m, of bracket arms

n : Number of end brackets.

1.4 Coefficients for pressure distribution correction

1.4.1 The scantlings of non-horizontal structural members are to be determined using the coefficients for pressure distribution correction λb and λS defined as follows:

$\lambda_s = 2\ \lambda_b - 1$

$$\lambda_b = 1 + 0,2 \left|\frac{p_d - p_u}{p_d + p_u}\right|$$

where:

p_u : Pressure, in kN/m², at the upper end of the structural member considered

$p_u = p_{su} + p_{wu}$

p_d : Pressure, in kN/m², at the lower end of the structural member considered

$p_d = p_{sd} + p_{wd}$

p_{su}, p_{wu} : Still water pressure and wave pressure respectively, in kN/m², at the upper end of the structural member considered

p_{sd}, p_{wd} : Still water pressure and wave pressure respectively, in kN/m², at the lower end of the structural member considered.

2 General requirements

2.1 Web minimum net thicknesses

2.1.1 The requirements in [2.1.2] are to be applied to ordinary stiffeners in addition of those in [3.1] and [4.1].

2.1.2 The net thickness, in mm, of the web of ordinary stiffeners is to be not less than:

- $t = 1,63 + 0,004\ L\ k^{1/2} + 4,5\ s$ for $L < 120$ m
- $t = 3,9\ k^{1/2} + s$ for $L \geq 120$ m

3 Yielding check

3.1 Application

3.1.1 The requirements of this Sub-article apply for the yielding check of ordinary stiffeners subjected to lateral pressure and, for ordinary stiffeners contributing to the hull girder longitudinal strength, to hull girder normal stresses.

The yielding check is also to be carried out for ordinary stiffeners subjected to specific loads, such as concentrated loads.

3.2 Load model

3.2.1 Lateral pressure in service conditions

The design lateral pressure, p, in service conditions to be used for hull scantling is to be determined according to Ch 5, Sec 2, [3.1.1].

3.2.2 Lateral pressure in testing conditions

The design lateral pressure, p, in service conditions to be used for hull scantling is to be determined according to Ch 5, Sec 2, [3.1.2].

3.2.3 Lateral pressure in flooding conditions

The design lateral pressure, p, in service conditions to be used for hull scantling is to be determined according to Ch 5, Sec 2, [3.1.3].

**Table 1 : Hull girder normal stresses
Structural members subjected to lateral pressure**

Condition		σ_{X1}, in N/mm²
Lateral pressure applied on the side opposite to the structural member, with respect to the plating	$z \geq N$	$10^5 \left\| \frac{M_{TS}}{I_Y}(z-N) \right\|$
	$z < N$	$10^5 \left\| \frac{M_{TH}}{I_Y}(z-N) \right\|$
Lateral pressure applied on the same side as the structural member	$z \geq N$	$10^5 \left\| \frac{M_{TH}}{I_Y}(z-N) \right\|$
	$z < N$	$10^5 \left\| \frac{M_{TS}}{I_Y}(z-N) \right\|$

3.2.4 Hull girder normal stresses

The hull girder normal stresses to be considered for the yielding check of structural members subjected to lateral pressure and contributing to the longitudinal strength are given in Tab 1.

3.3 Net section modulus and net shear sectional area of ordinary stiffeners

3.3.1 The net section modulus w, in cm³, and the net shear sectional area A_{Sh} , in cm², of ordinary stiffeners subjected to lateral pressure are to be not less than the values obtained from Tab 2.

4 Buckling strength check

4.1 Load model

4.1.1 Hull girder normal compression stresses

The hull girder normal compression stresses to be considered for the buckling strength check of the structural members which contribute to the longitudinal strength are given in Ch 5, Sec 2, Tab 5.

4.2 Checking criteria

4.2.1 The critical buckling stress of ordinary stiffeners is to comply with NR217, Pt B, Ch 2, Sec 6, [3].

Table 2 : Net scantlings of ordinary stiffeners

Conditions	Structural item	w, in cm³	A_{sh}, in cm²
Service and flooding	Longitudinal stiffeners	$w = \gamma_R \beta_b \frac{p}{m(230/k - \gamma_R \sigma_{X1})} s \ell^2 10^3$	$A_{sh} = 10\gamma_R \beta_s \frac{p}{230/k} \eta s \ell$
	Transverse stiffeners	$w = \gamma_R \beta_b \frac{p}{m(230/k)} s \ell^2 10^3$	
	Vertical stiffeners (other than side frames)	$w = \gamma_R \lambda_b \beta_b \frac{p}{m(230/k)} s \ell^2 10^3$	$A_{sh} = 10\gamma_R \lambda_s \beta_s \frac{p}{230/k} \eta s \ell$
	Side frames: • $\ell_0 \leq \ell$	$w = \gamma_R \beta_b \frac{s}{m(230/k)}(6\ell\ell_0^2 + 1,45\lambda_W p_F \ell_F^2)10^3$	$A_{sh} = 68 k_1 \gamma_R \beta_s \frac{\ell}{230/k} \eta s \ell_0$
	• $\ell_0 > \ell$	$w = \gamma_R \beta_b \frac{s}{m(230/k)}(\lambda_b p \ell^2 + 1,45\lambda_W p_F \ell_F^2)10^3$	$A_{sh} = 10 k_1 \gamma_R \lambda_s \beta_s \frac{p}{230/k} \eta s \ell$
Testing	Longitudinal stiffeners Transverse stiffeners	$w = \gamma_R \beta_b \frac{p}{m(230/k)} s \ell^2 10^3$	$A_{sh} = 10\gamma_R \beta_s \frac{p}{230/k} \eta s \ell$
	Vertical stiffeners (other than side frames)	$w = \gamma_R \lambda_b \beta_b \frac{p}{m(230/k)} s \ell^2 10^3$	$A_{sh} = 10\gamma_R \lambda_s \beta_s \frac{p}{230/k} \eta s \ell$
	Side frames: • $\ell_0 \leq \ell$	$w = \gamma_R \beta_b \frac{s}{m(230/k)}(6\ell\ell_0^2 + 1,45\lambda_W p_F \ell_F^2)10^3$	$A_{sh} = 68 k_1 \gamma_R \beta_s \frac{\ell}{230/k} \eta s \ell_0$
	• $\ell_0 > \ell$	$w = \gamma_R \beta_b \frac{s}{m(230/k)}(\lambda_b p \ell^2 + 1,45\lambda_W p_F \ell_F^2)10^3$	$A_{sh} = 10 k_1 \gamma_R \lambda_s \beta_s \frac{p}{230/k} \eta s \ell$

m : Boundary coefficient
m = 12, in general
ℓ_F : Floor span, in m
ℓ_0 : Span parameter, in m, equal to:
$\ell_0 = p_d / 9,81$
p_d : Total pressure, in kN/m², at the lower end of the stiffener
p_F : Floor design lateral pressure, in kN/m²
λ_W : Coefficient to be taken equal to:
- single side : $\lambda_W = 0,08$
- double side: $\lambda_W = 0$

k_1 : Coefficient defined as:
- single side: $k_1 = 1,3$
- double side: $k_1 = 1$

Note 1: The value of σ_{X1} is to be taken in relation with the pressure p considered. See Tab 1.

SECTION 4 PRIMARY SUPPORTING MEMBERS

1 General

1.1 Application

1.1.1 The requirements of this Article apply to the yielding and column buckling checks of primary supporting members.

1.2 Minimum net thicknesses

1.2.1 The net thickness, in mm, of the web of primary supporting members is to be not less than:

$t = 3,8 + 0,016\ L\ k^{1/2}$

2 Yielding check of primary supporting members analysed through an isolated beam structural model

2.1 General requirements

2.1.1 Load point for lateral pressure

Unless otherwise specified, lateral pressure is to be calculated at mid-span of the primary supporting member considered.

2.1.2 Load point for hull girder normal stresses

For longitudinal primary supporting members contributing to the hull girder longitudinal strength, the hull girder normal stresses are to be calculated in way of the neutral axis of the primary supporting member with attached plating.

2.1.3 Span correction coefficients

Conventional parameters of end brackets are given in Fig 1. Special consideration is to be given to conditions different from those shown.

The span correction coefficients β_b and β_s, of primary supporting members are to be determined using the following formulae:

$$\beta_b = \left(1 - \sum_{i=1}^{n} \frac{\ell_{bi}}{\ell}\right)^2$$

$$\beta_S = \left(1 - \sum_{i=1}^{n} \frac{\ell_{bi}}{\ell}\right)$$

where:

ℓ : Span, in m, of primary supporting member, defined in Ch 2, Sec 5, [4.1]

$\ell_{bi} = \ell_b - 0,25\ h_W$

$\ell_b = \text{MIN}\ (d\ ;\ b)$

d, b : Length, in m, of bracket arms, defined in Fig 1

h_W : Height, in m, of the primary supporting member (see Fig 1)

n : Number of end brackets.

2.1.4 Coefficients for pressure distribution correction

The scantlings of non-horizontal structural members are to be determined using the coefficients for pressure distribution correction λ_b and λ_S defined in Ch 5, Sec 3, [1.4.1].

2.2 Load model

2.2.1 Lateral pressures

The design lateral pressures are to be determined in compliance with Ch 5, Sec 2, [3.1.1] to Ch 5, Sec 2, [3.1.3].

2.2.2 Hull girder normal stresses

The hull girder normal stresses to be considered for the yielding check of structural members subjected to lateral pressure and contributing to the longitudinal strength are given in Ch 5, Sec 3, Tab 1.

2.3 Net section modulus and net shear sectional area of primary supporting members

2.3.1 The net section modulus w, in cm3, and the net shear sectional area A_{Sh}, in cm^2, of primary supporting members subjected to lateral pressure are to be not less than the values obtained from Tab 1.

3 Buckling of pillars subjected to compression axial load

3.1 General

3.1.1 Pillars or other supporting structures are generally to be fitted under heavy concentrated loads.

Structural members at heads and heels of pillars as well as substructures are to be constructed according to the forces they are subjected to. The connection is to be so dimensioned that at least 1 cm^2 cross sectional area is available for 10 kN of load.

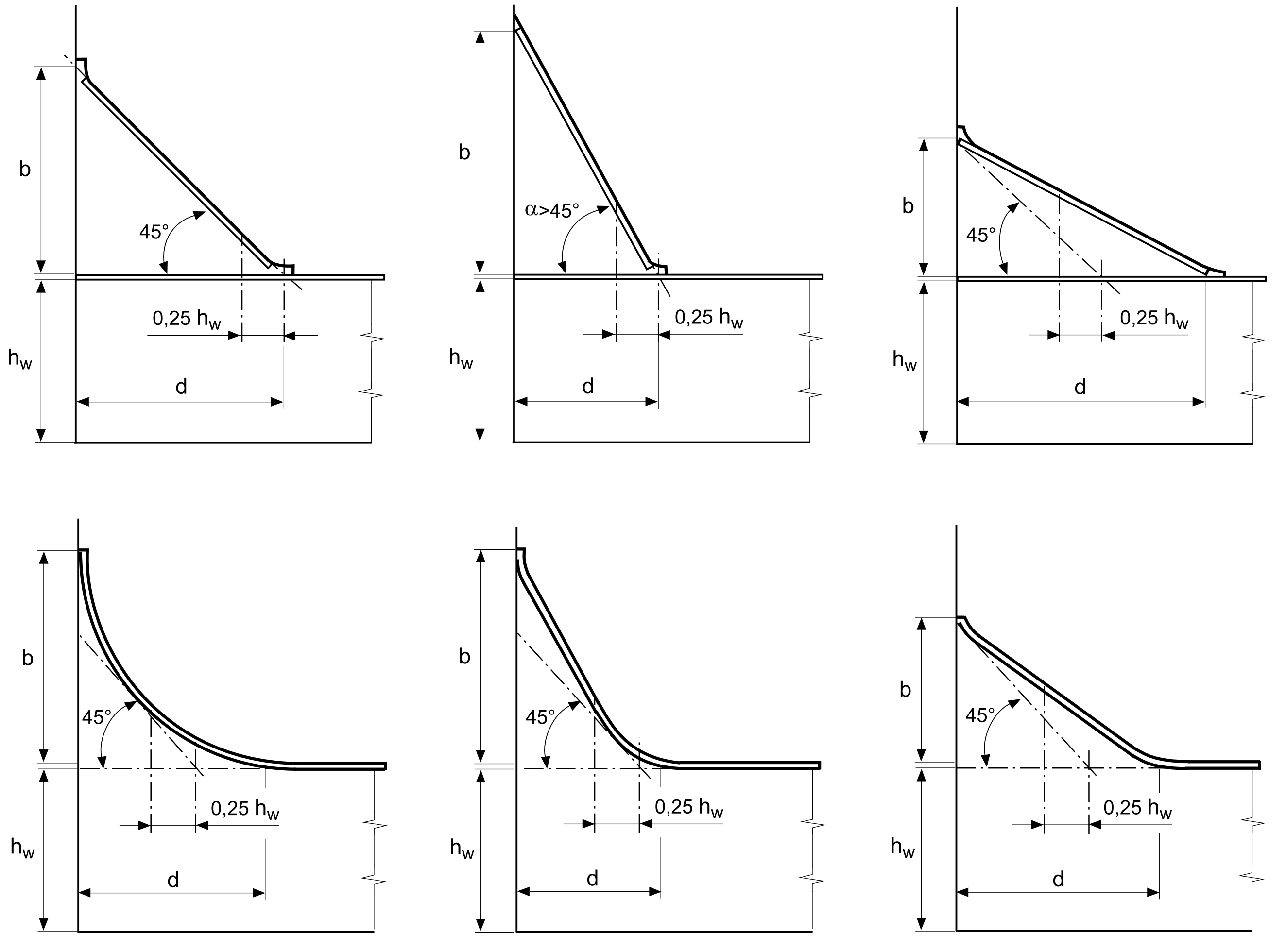
Where pillars are affected by tension loads doublings are not permitted.

Pillars in tanks are to be checked for tension.

Tubular pillars are not permitted in tanks for flammable liquids.

Pillars are to be fitted, as far as practicable, in the same vertical line.

Figure 1 : Characteristics of primary supporting member brackets



3.1.2 Connections

Pillars are to be attached at their heads and heels by continuous welding.

Pillars working under pressure may be fitted by welds only, in the case the thickness of the attached plating is at least equal to the thickness of the pillar.

Where the thickness of the attached plating is smaller than the thickness of the pillar, a doubling plate is to be fitted.

Heads and heels of pillars which may also work under tension (such as those in tanks) are to be attached to the surrounding structure by means of brackets or insert plates so that the loads are well distributed.

Pillars are to be connected to the inner bottom, where fitted, at the intersection of girders and floors.

Where pillars connected to the inner bottom are not located in way of intersections of floors and girders, partial floors or girders or equivalent structures suitable to support the pillars are to be arranged.

Manholes and lightening holes may not be cut in the girders and floors below the heels of pillars.

3.2 Buckling strength

3.2.1 Where pillars are in line, the compression axial load in a pillar is obtained, in kN, from the following formula:

$$F_A = A_D(p_S + p_W) + \sum_{i=1}^{N} r_i(Q_{i,S} + Q_{i,W})$$

where:

A_D : Area, in m², of the portion of the deck or platform supported by the pillar considered

r_i : Coefficient which depends on the relative position of each pillar above the one considered, to be taken equal to:

- ri = 0,9 for the pillar immediately above that considered (i = 1)
- ri = 0,9i for the ith pillar of the line above the pillar considered, to be taken not less than 0,478

$Q_{i,S}$, $Q_{i,W}$: Still water and additional loads, respectively, in kN, from the ith pillar of the line above the pillar considered.

p_S : Still water pressure, in kN/m², on the deck supported by the pillar, see Ch 3, Sec 3, [1]

p_W : Additional pressure, in kN/m², on the deck supported by the pillar, see Ch 3, Sec 3, [1]

Table 1 : Net scantlings of primary supporting members

Conditions	Structural item	w, in cm^3	A_{sh}, in cm^2
Service and flooding	Longitudinal members	$w = \gamma_R \beta_b \frac{p}{m(230/k - \gamma_R \sigma_{X1})} S \ell^2 10^3$	$A_{sh} = 10\gamma_R\beta_s \frac{p}{230/k} S\ell$
	Transverse members	$w = \gamma_R\beta_b \frac{p}{m(230/k)} S\ell^2 10^3$	
	Vertical members	$w = \gamma_R\lambda_b\beta_b\frac{p}{m(230/k)}S\ell^2 10^3$	$A_{sh} = 10\gamma_R\lambda_S\beta_s \frac{p}{230/k}S\ell$
	Side web frames Side transverses • $\ell_0 \le \ell$	$w = 6\gamma_R\beta_b\frac{\ell}{m(230/k)}S\ell_0^2 10^3$	$A_{sh} = 68\gamma_R\beta_s\frac{\ell}{230/k}S\ell_0$
	• $\ell_0 > \ell$	$w = \gamma_R\lambda_b\beta_b\frac{p}{m(230/k)}S\ell^2 10^3$	$A_{sh} = 10\gamma_R\lambda_S\beta_s \frac{p}{230/k}S\ell$
Testing	Longitudinal members	$w = \gamma_R\beta_b \frac{p}{m(230/k)} S\ell^2 10^3$	$A_{sh} = 10\gamma_R\beta_s \frac{p}{230/k} S\ell$
	Transverse members		
	Vertical members	$w = \gamma_R\lambda_b\beta_b\frac{p}{m(230/k)}S\ell^2 10^3$	$A_{sh} = 10\gamma_R\lambda_S\beta_s \frac{p}{230/k}S\ell$
	Side web frames Side transverses • $\ell_0 \le \ell$	$w = 6\gamma_R\beta_b\frac{\ell}{m(230/k)}S\ell_0^2 10^3$	$A_{sh} = 68\gamma_R\beta_s\frac{\ell}{230/k}S\ell_0$
	• $\ell_0 > \ell$	$w = \gamma_R\lambda_b\beta_b\frac{p}{m(230/k)}S\ell^2 10^3$	$A_{sh} = 10\gamma_R\lambda_S\beta_s \frac{p}{230/k}S\ell$

m : Boundary coefficient
$m = 8$, in general

ℓ_0 : Span parameter, in m
$\ell_0 = p_d / 9{,}81$

p_d : Total pressure, in kN/m^2, at the lower end of the stiffener

Note 1: The value of σ_{X1} is to be taken in relation with the pressure p considered. See Ch 5, Sec 3, Tab 1.

The critical column buckling stress of pillars is to be obtained, in N/mm2, from the following formulae:

$$\sigma_{cB} = \sigma_{E1} \quad \text{for} \quad \sigma_{E1} \le \frac{R_{eH}}{2}$$

$$\sigma_{cB} = R_{eH}\left(1 - \frac{R_{eH}}{4\sigma_{E1}}\right) \quad \text{for} \quad \sigma_{E1} > \frac{R_{eH}}{2}$$

where:

σ_{E1} : Euler column buckling stress, to be obtained, in N/mm^2, from the following formula:

$$\sigma_{E1} = 206 k_0 \frac{I}{A(f\ell)^2}$$

I : Minimum net moment of inertia, in cm^4, of the pillar

A : Net cross-sectional area, in cm^2, of the pillar

ℓ : Span, in m, of the pillar

f : Coefficient, to be obtained from Tab 3.

The critical local buckling stress of built-up pillars is to be obtained, in N/mm^2, from the following formulae:

$$\sigma_{cL} = \sigma_{E3} \quad \text{for} \quad \sigma_{E3} \le \frac{R_{eH}}{2}$$

$$\sigma_{cL} = R_{eH}\left(1 - \frac{R_{eH}}{4\sigma_{E3}}\right) \quad \text{for} \quad \sigma_{E3} > \frac{R_{eH}}{2}$$

where:

σ_{E3} : Euler local buckling stress, to be taken equal to the lesser of the values obtained, in N/mm^2, from the following formulae:

- $\sigma_{E3} = 78\left(\frac{t_W}{h_W}\right)^2 10^4$
- $\sigma_{E3} = 32\left(\frac{t_F}{b_F}\right)^2 10^4$

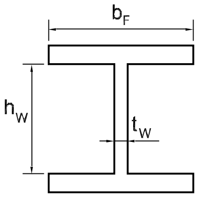
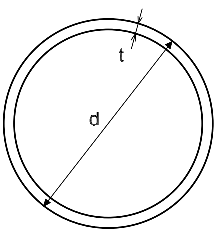
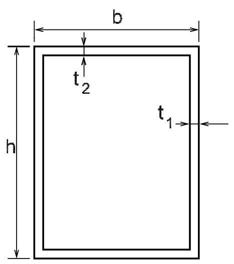
h_W : Web height of built-up section, in mm

t_W : Net web thickness of built-up section, in mm

b_F : Face plate width of built-up section, in mm

t_F : Net face plate thickness of built-up section, in mm.

Table 2 : Buckling check of pillars subject to compression axial load

Pillar cross-section	Column buckling check	Local buckling check	Geometric condition
Built-up 	$\frac{\sigma_{cB}}{1,02\gamma_R} \geq 10\frac{F_A}{A}$	$\frac{\sigma_{cL}}{1,02\gamma_R} \geq 10\frac{F_A}{A}$	• $\frac{b_F}{t_F} \leq 40$
Hollow tubular 	$\frac{\sigma_{cB}}{1,02\gamma_R} \geq 10\frac{F_A}{A}$	Not required	• $\frac{d}{t} \leq 55$ • $t \geq 5,5$ mm
Hollow rectangular 	$\frac{\sigma_{cB}}{1,02\gamma_R} \geq 10\frac{F_A}{A}$	$\frac{\sigma_{cL}}{1,02\gamma_R} \geq 10\frac{F_A}{A}$	• $\frac{b}{t_2} \leq 55$ • $\frac{h}{t_1} \leq 55$ • $t_1 \geq 5,5$ mm • $t_2 \geq 5,5$ mm

Note 1:

σ_{cB} : Critical column buckling stress, in N/mm^2, defined in [3.2.1]

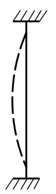
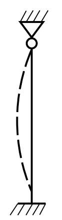
σ_{cL} : Critical local buckling stress, in N/mm^2, defined in [3.2.1] for hollow rectangular section

γ_R : Resistance partial safety factor, equal to:
- 1,15 for column buckling
- 1,05 for local buckling

F_A : Compression axial load in the pillar, in kN, defined in [3.2.1]

A : Net sectional area, in cm^2, of the pillar.

Table 3 : Coefficient f

	Both ends fixed	**One end fixed, one end pinned**	**Both ends pinned**
Boundary conditions of the pillar			
f	0,5	$\frac{\sqrt{2}}{2}$	1

The critical local buckling stress of pillars having hollow rectangular section is to be obtained, in N/mm², from the following formulae:

$$\sigma_{cL} = \sigma_{E4} \quad \text{for} \quad \sigma_{E4} \le \frac{R_{eH}}{2}$$

$$\sigma_{cL} = R_{eH}\left(1 - \frac{R_{eH}}{4\sigma_{E4}}\right) \quad \text{for} \quad \sigma_{E4} > \frac{R_{eH}}{2}$$

where:

σ_{E4} : Euler local buckling stress, to be taken equal to the lesser of the values obtained, in N/mm², from the following formulae:

- $\sigma_{E4} = 78\left(\frac{t_2}{b}\right)^2 10^4$
- $\sigma_{E4} = 78\left(\frac{t_1}{h}\right)^2 10^4$

b : Length, in mm, of the shorter side of the section

t_2 : Net web thickness, in mm, of the shorter side of the section

h : Length, in mm, of the longer side of the section

t_1 : Net web thickness, in mm, of the longer side of the section.

The net scantlings of the pillar loaded by the compression axial stress F_A defined in [3.2.1] are to comply with the formulae in Tab 2.

4 Direct calculation

4.1 Application

4.1.1 The requirements of this Article give direct calculation guidance for the yielding and buckling checks of structural members.

Direct calculation may be adopted instead of Rule scantling formulae or for the analysis of structural members not covered by the Rules.

4.1.2 Yielding check

The yielding check is to be carried out according to:

- [4.4] for structural members analysed through isolated beam models
- [4.5] for structural members analysed through three dimensional beam or finite element models

4.1.3 Buckling check

The buckling check is to be carried out according to NR217, Pt B, Ch 2, Sec 6, on the basis of the stresses in primary supporting members calculated according to [4.4] or [4.5], depending on the structural model adopted.

4.2 Analysis documentation

4.2.1 The following documents are to be submitted to the Society for review / approval of the three dimensional beam or finite element structural analyses:

- reference to the calculation program used with identification of the version number and results of the validation test, if the results of the program have not been already submitted to the Society approval
- extent of the model, element types and properties, material properties and boundary conditions
- loads given in print-out or suitable electronic format. In particular, the method used to take into account the interaction between the overall, primary and local loadings is to be described. The direction and intensity of pressure loads, concentrated loads, inertia and weight loads are to be provided
- stresses given in print-out or suitable electronic format
- buckling checks
- identification of the critical areas, where the results of the checkings exceed 97,5% of the permissible Rule criteria for yielding and buckling.

4.2.2 According to the results of the submitted calculations, the Society may request additional runs of the model with structural modifications or local mesh refinements in highly stressed areas.

4.3 Resistance partial safety factor

4.3.1 The values of resistance partial safety factor covering uncertainties on resistance to be considered for checking structural members are specified in Tab 4 for analyses based on different calculation models.

Table 4 : Resistance partial safety factor γ_R

Calculation model	Yielding check		Buckling check
	General	Flooding conditions	
- in general - bottom and side girders - end bulkheads	1,02 1,15 NA	1,02 NA 1,25	1,10
Three dimensional beam model	1,20	1,02	1,02
Coarse mesh finite element model	1,20	1,02	1,02
Fine mesh finite element model	1,05	1,02	1,02
Note 1: NA = not applicable.			

4.4 Yielding check of structural members analysed through an isolated beam structural model

4.4.1 General

The requirements of this Subarticle apply to the yielding check of structural members subjected to lateral pressure or to wheeled loads and, for those contributing to the hull girder longitudinal strength, to hull girder normal stresses, which may be analysed through an isolated beam model.

The yielding check is also to be carried out for structural members subjected to specific loads, such as concentrated loads.

4.4.2 Load point

Unless otherwise specified, lateral pressure is to be calculated at mid-span of the structural member considered.

For longitudinal structural members contributing to the hull girder longitudinal strength, the hull girder normal stresses are to be calculated in way of the neutral axis of the structural member with attached plating.

4.4.3 Load model

The external pressure and the pressures induced by the various types of loads and ballast are to be considered, depending on the location of the structural member under consideration and the type of compartments adjacent to it, in accordance with Ch 3, Sec 3, [1].

The pressure load in service conditions is to be determined according to Ch 3, Sec 3, [1].

For structural members subjected to wheeled loads, the yielding check may be carried out according to [4.4.4] considering uniform pressures equivalent to the distribution of vertical concentrated forces, when such forces are closely located, taking into account the most unfavourable case.

The hull girder normal stresses to be considered for the yielding check of structural members are to be determined according to Ch 4, Sec 2, [1.1].

4.4.4 Checking criteria

It is to be checked that the normal stress σ and the shear stress τ are in compliance with the following formulae:

$$\frac{0,98 R_{eH}}{\gamma_R} \geq \sigma$$

$$0,49 \frac{R_{eH}}{\gamma_R} \geq \tau$$

4.5 Yielding check of structural members analysed through a three dimensional structural model

4.5.1 General

The requirements of this Subarticle apply to the yielding check of structural members subjected to lateral pressure or to wheeled loads and, for those contributing to the hull girder longitudinal strength, to hull girder normal stresses, which are to be analysed through a three dimensional structural model.

The yielding check is also to be carried out for structural members subjected to specific loads, such as concentrated loads.

4.5.2 Analysis criteria

The analysis of structural members based on three dimensional models is to be carried out according to the requirements in:

- NR217, Pt B, Ch 5, App1 for structural members subjected to lateral pressure
- NR217, Pt B, Ch 5, App 2 for structural members subjected to wheeled loads.

These requirements apply to:

- the structural modelling
- the load modelling
- the stress calculation.

4.5.3 Checking criteria

a) Master allowable stress

The master allowable stress, σ_{MASTER}, in N/mm², is to be obtained from the following formula:

$$\sigma_{MASTER} = \frac{0,98 R_{eH}}{\gamma_R}$$

b) For all types of analysis (see NR217, Pt B, Ch 5, App1, [2]), it is to be checked that the equivalent Von Mises stress σ_{VM}, calculated according to NR217, Pt B, Ch 5, App1, [5] is in compliance with the following formula:

$$\sigma_{VM} \leq \sigma_{MASTER}$$

c) Structural detail analysis based on very fine mesh finite elements models

In fine mesh model as defined with reference to NR217, Pt B, Ch 5, App1, [3.4.3], high stress areas for which σ_{VM} exceeds $0,95\sigma_{MASTER}$ are to be investigated through a very fine mesh structural detail analysis according to NR217, Pt B, Ch 5, App1, [3.4.4], and both following criteria are to be checked:

- The average Von Mises equivalent stress σ_{VM-av} as defined in d) is to comply with the following formula:

  $$\sigma_{VM-av} \leq \sigma_{MASTER}$$

- The equivalent stress σ_{VM} of each element is to comply with the following formulae:

  - for elements not adjacent to the weld

  $$\sigma_{VM} \leq 1,53\sigma_{MASTER}$$

  - for elements adjacent to the weld

  $$\sigma_{VM} \leq 1,34\sigma_{MASTER}$$

d) Stress averaging on very fine mesh

The average Von Mises equivalent stress σ_{VM-av}, in N/mm², is to be obtained from the following formula:

$$\sigma_{VM-av} = \frac{\sum_1^n A_i \sigma_{VM-i}}{\sum_1^n A_i}$$

where:

σ_{VM-i} : Von Mises stress at the centre of the i-th element within the considered area, in N/mm²

A_i : Area of the i-th element within the considered area, in mm²

n : Number of elements within the considered area.

Stress averaging is to be performed over an area defined as follows:

- the area considered for stress averaging is to have a size not above the relevant spacing of ordinary stiffeners (s x s)
- for very fine mesh along rounded edges (openings, rounded brackets) the area considered for stress averaging is to be limited only to the first ring of border elements, over a length not greater than the relevant spacing of ordinary stiffeners
- the area considered for stress averaging is to include an entire number of elements
- the area considered for stress averaging is not to be defined across structural discontinuities, web stiffeners or other abutting structure
- for regions where several different stress averaging areas may be defined, the worst is to be considered for the calculation of average Von Mises equivalent stress.

e) Particular requirements

For very fine mesh regions located on brackets webs in the vicinity of bracket toes, where an equivalent (s x s) area cannot be defined, the yielding check is to be based only on the criteria given in the second item of c).

Other structural details having shapes not allowing the stress averaging as required in d) are to be specially considered by the Society, on a case by case basis.

4.6 Torsion of catamarans

4.6.1 A method for the determination of scantlings of deck beams connecting the hulls of a catamaran subjected to torsional moment is given in NR217, Pt B, Ch 5, App 3.

Part B
Hull and Stability

Chapter 6
OTHER STRUCTURES

SECTION 1 END PART STRUCTURES

1 General

1.1 General

1.1.1 Application

The requirements of this Section apply to all floating establishments for the arrangement of the end part structures as defined in Ch 1, Sec 1, [2.1.3].

As to the requirements which are not explicitly dealt with in the present Section, refer to the previous Sections.

1.1.2 Tapering

Adequate tapering is to be ensured between the scantlings of the end part structures and those of the central part. The tapering is to be such that the scantling requirements for both areas are fulfilled.

1.2 Scantlings

1.2.1 The scantlings of end part structural members are to comply with Part B, Chapter 5, taking $\sigma_{X1} = 0$.

1.3 Bottom structural arrangement

1.3.1 Longitudinally framed bottom

Bottom transverses are to be fitted at every 8 frame spacings and generally spaced no more than 4 m apart.

The arrangements of bottom transverses are to be as required in the midship region.

Their scantlings are not to be less than required in Ch 5, Sec 1 nor lower than those of the corresponding side transverses.

Where no centreline bulkhead is fitted, a centre bottom girder having the same dimensions and scantlings as required for bottom transverses is to be provided.

The centre bottom girder is to be connected to the end bulkhead by means of a large end bracket.

Side girders, having the same dimensions and scantlings as required for bottom transverses, are generally to be fitted every two longitudinals, in line with bottom longitudinals located beyond the end bulkhead. Their extension is to be compatible in each case with the shape of the bottom.

1.3.2 Transversely framed bottom

Floors are to be fitted at every frame spacing.

A relaxation from the Rules of dimensions and scantlings may be granted by the Society for very low draught units.

Where no centreline bulkhead is fitted, a centre bottom girder is to be provided according to [1.3.1].

1.4 Side structural arrangement

1.4.1 Arrangement

In way of the anchors, the side plating thickness is to be increased by 50%, or a doubling plate is to be provided.

Where a break is located in the end part deck, the thickness of the sheerstrake is to be increased by 40% in the region of the break.

1.4.2 Longitudinally framed side

Side transverses are to be located in way of bottom transverses and are to extend to the upper deck. Their ends are to be amply faired in way of bottom and deck transverses.

1.4.3 Transversely framed side

Side frames fitted at every frame space are to have the same vertical extension as the end bulkhead.

Where, due to the hull design, the distance between transverse stiffeners, measured on the plating, is quite greater than the frame spacing, this latter should be reduced, or intermediate frames with adequate scantlings, are to be provided.

It is recommended to provide a side stringer where intermediate frames are fitted over a distance equal to the breadth B of the unit.

The value of the side frame section modulus is generally to be maintained for the full extension of the side frame.

The web frames in a transverse framing system are to be spaced not more than 4 m apart.

The web frame section modulus is to be equal to the section modulus of the floor connected to it.

Depending on the hull body shape and structure beyond the end bulkhead, one or more adequately spaced side stringers per side are to be fitted.

Manholes may be cut in the structural members to provide convenient access to all parts of the peaks.

These manholes are to be cut smooth along a well rounded design and are not to be greater than that strictly necessary to provide the man access. Where manholes of greater sizes are needed, edge reinforcement by means of flat bar rings or other suitable stiffeners may be required.

1.5 Deck structural arrangement

1.5.1 Where a break is located in the end part deck, the thickness of the sheerstrake is to be increased by 40% in the region of the break.

The deck plating is to be reinforced in way of the deck machinery, bollards, cranes, masts and derrick posts.

SECTION 2 SUPERSTRUCTURES

1 General

1.1 Application

1.1.1 The requirements of this Section apply to structural members of superstructures, which may or may not contribute to the longitudinal strength.

As to the requirements which are not explicitly dealt with in the present Section, refer to the previous Sections.

1.2 Definitions

1.2.1 Superstructures

Superstructures are defined in Ch 1, Sec 2, [1.7].

Superstructures may be:

- closed, where they are enclosed by front, side and aft bulkheads complying with the requirements of this Section, the openings of which are fitted with weathertight means of closing
- open, where they are not enclosed.

1.2.2 Superstructures contributing to the longitudinal strength

A superstructure may be considered as contributing to the longitudinal strength if its deck satisfies the basic criteria given in Ch 4, Sec 1, [3.2].

1.2.3 Tiers of superstructures

The lowest tier is normally that which is directly situated above the strength deck defined in Ch 1, Sec 2, [1.8].

The second tier is that located immediately above the lowest tier, and so on.

2 Arrangements

2.1 Connections of superstructures with the hull structure

2.1.1 Superstructure frames are to be fitted as far as practicable as extensions of those underlying and are to be effectively connected to both the latter and the deck beams above.

Ends of superstructures are to be efficiently supported by bulkheads, diaphragms, webs or pillars.

2.1.2 Connection to the deck of corners of superstructures is considered by the Society on a case by case basis. Where necessary, doublers or reinforced welding may be required.

2.1.3 As a rule, the frames of sides of superstructures are to have the same spacing as the beams of the supporting deck.

Web frames are to be arranged to support the sides and ends of superstructures.

2.1.4 The side plating at ends of superstructures is to be tapered into the bulwark or sheerstrake of the strength deck.

Where a raised deck is fitted, this arrangement is to extend over at least 3 frame spacings.

2.2 Gastight bulkheads

2.2.1 The accommodation shall be separated from machinery spaces by gastight bulkheads.

2.3 Local reinforcements

2.3.1 Local reinforcements are to be foreseen in way of areas supporting wheeled loads or ladders.

3 Design loads

3.1 Sides and bulkheads

3.1.1 The lateral pressure to be used for the determination of scantlings of structure of sides and bulkheads of superstructures is p = 2,25 kN/m^2.

3.2 Pressure on decks

3.2.1 Pressure due to load carried on deck

The lateral pressure, p, in kN/m^2, transmitted to the deck structure, is to be defined by the Designer. In general, p is not be taken less than the values given in Tab 1 or Tab 2

Table 1 : Deck pressure in accommodation compartments

Type of accommodation compartment	p, in kN/m^2
• Large spaces, such as restaurants, halls, cinemas, lounges, kitchen, service spaces, games and hobbies rooms, hospitals	4,0
• Bedrooms	3,0
• Other compartments	2,5

Table 2 : Pressure on exposed decks

Exposed deck location	p_S, in kN/m^2
• First tier (non public)	2,0
• Upper tiers (non public)	1,5
• Public	4,0

4 Scantlings

4.1 General

4.1.1 The Society may ask additional arrangements deemed necessary in order to keep, in acceptable limits, the level of stresses liable to occur in the superstructure structural members.

4.1.2 The hull girder section modulus to be used for the scantling of hull and contributing superstructures, is to be determined in compliance with Ch 4, Sec 1, [2], Ch 4, Sec 1, [3], taking into account the strength deck or the contributing deck up to which extends the considered superstructure.

4.1.3 The scantlings of the structural members of superstructures are to comply with Part B, Chapter 5, using the design loads defined in [3] and taking into account the additional requirements of [4.1.4] and [4.1.5].

4.1.4 Minimum net thickness of plating of superstructures not contributing to the longitudinal strength

The minimum net thickness of plating, in mm, of not contributing superstructures is to be derived from the following formulae:

a) $t = 3,5 + 0,01Lk^{0,5}$

for:

- sides
- end bulkheads
- not exposed deck

b) $t = 4,0 + 0,01Lk^{0,5}$

for exposed decks

4.1.5 Scantling of vertical stiffeners

The net scantlings of vertical stiffeners derived from Ch 5, Sec 1 are to be multiplied by the coefficient k_1 defined as:

$k_1 = 1 + 0,1\ n_t$

where:

n_t : Number of tiers above the tier considered.

5 Transverse strength check

5.1 General

5.1.1 The existing constructive dispositions must ensure an effective racking strength of the superstructures notably the end bulkheads, the partial or complete intermediate bulkheads and the greatest possible number of continuous and complete gantries.

Scantlings of primary structural members contributing to the transverse strength of superstructures are to be supported by direct calculation, according to guidance defined in this Article.

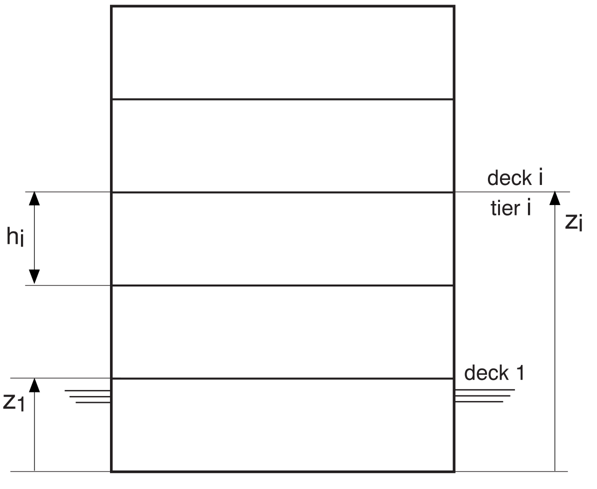
5.2 Loads due to list and wind action

5.2.1 General

The loads inducing the racking in the unit superstructures above deck 1 (see Fig 1) are as follows:

- structural horizontal load P_S
- non structural horizontal load P_C
- wind load P_W.

Figure 1 : Height and location of tier i



5.2.2 Definitions

The following parameters are used for the determination of loads inducing racking:

φ : Angle of list up to which no non-watertight opening to a non-flooded compartment reaches the water level, to be derived from damaged stability calculation

Where this value is not known, φ is to be taken equal to 12°

p_{WD} : Specific wind pressure

$p_{WD} = 0,25$ kN/m^2

h_i : Height, in m, of tier i of superstructure (see Fig 1)

b_i : Width, in m, of tier i of superstructure

S : Spacing, in m, of primary supporting members.

5.2.3 Structural horizontal load

The structural horizontal load, in kN, between successive gantries or transverse bulkheads, acting on deck i is given by the formula:

$P_{Si} = 9,81\ m_{Si} \sin \varphi$

where:

m_{Si} : Structural mass, in t, of tier i of superstructure, between successive gantries or bulkheads.

The following indicated value may be adopted:

$m_{Si} = 0,08\ S\ h_i\ b_i$

5.2.4 Non structural horizontal load

The non structural horizontal load, in kN, between successive gantries or transverse bulkheads, acting on deck i is given by the formula:

$P_{Ci} = p_i \, S \, b_i \sin \varphi$

where:

p_i : Design pressure on deck i, in kN/m^2, defined in Tab 1 or Tab 2.

5.2.5 Wind load

The wind load, in kN, between successive gantries or transverse bulkheads, acting on deck i is given by the formula:

$P_W = p_{WD} \, S \, (h_i + h_{i+1}) / 2$

5.3 Inertial loads

5.3.1 General

The following inertial loads inducing racking in the unit superstructures above deck 1 (see Fig 1) are to be taken into account:

- structural horizontal load, P_{SR}, induced by roll acceleration
- non structural horizontal load, P_{CR}, induced by roll acceleration.

5.3.2 Definitions

Following parameters are used for the determination of inertial loads inducing racking:

h_i : Height, in m, of tier i of superstructure (see Fig 1)

b_i : Width, in m, of tier i of superstructure

z_i : Height, in m, of deck i above base line (see Fig 1)

z_G : Height, in m, of rolling centre above base line

z_G may be considered as the vertical centre of gravity when no information is available

T_R : Motion period, in s:

$$T_R = \frac{0,77B}{\sqrt{GM}}$$

GM : Distance, in m, from the unit's centre of gravity to the transverse metacentre, for the loading considered; when GM is not known, its value may be determined using the following formula:

GM = 0,07 B

a_R : Motion acceleration, in m/s^2:

$$a_R = \frac{40\varphi(z_i - z_G)}{T^2_R}$$

φ : Angle of list, in radian, defined in [5.2.2].

5.3.3 Structural horizontal inertial load

The structural horizontal inertial load, in kN, between successive gantries or transverse bulkheads, acting on deck i is given by the formula:

$P_{SRi} = m_{Si} \, a_R$

where:

m_{Si} : Structural mass, in t, defined in [5.2.3].

5.3.4 Non structural horizontal inertial load

The non structural horizontal inertial load, in kN, between successive gantries or transverse bulkheads, acting on deck i is given by the formula:

$$P_{CRi} = \frac{p_i S b_i a_R}{9,81}$$

where:

p_i : Design pressure on deck i, in kN/m^2, defined in Tab 1 or Tab 2.

5.4 Racking analysis

5.4.1 General

The racking analysis is performed for checking strength of structure against lateral horizontal loads due to list and wind action defined in [5.2] and, eventually, to inertial loads induced by the unit motion.

5.4.2 Analysis methodology

The following methodology is to be followed for checking strength of structure above the lowest deck (so called deck 1 in Fig 1):

a) Calculation of transverse forces

- determination of structural horizontal load on each deck, above deck 1, according to [5.2.3] and, eventually, [5.3.3]
- determination of non structural horizontal load on each deck, above deck 1, according to [5.2.4] and, eventually, [5.3.4]
- determination of wind load on each deck above deck 1 according to [5.2.5].

b) Distribution of transverse forces

- distribution of these loads on vertical structural members efficiently acting against racking

c) Analysis of transverse structures.

5.4.3 Checking criteria

It is to be checked that the normal stress σ, the shear stress τ and the equivalent stress σ_{VM} are in compliance with the following formulae:

$$\frac{0,98R_{eH}}{\gamma_R} \geq \sigma$$

$$\frac{0,49R_{eH}}{\gamma_R} \geq \tau$$

$$\frac{0,98R_{eH}}{\gamma_R} \geq \sigma_{VM}$$

where:

R_{eH} : Minimum yield stress, in N/mm^2, of the material

γ_R : Partial safety factor covering uncertainties regarding resistance, to be taken equal to 1,20.

6 Scantling of window stiles

6.1 General

6.1.1 The geometric characteristics of the hull girder to be used for the scantling of window stiles are to be determined in compliance with Ch 4, Sec 1, [3], assuming that the hull girder extends up to the uppermost contributing superstructure deck.

6.1.2 Forces in the window stile

a) Local shear force, in kN

$$F = \frac{\tau}{2} \cdot t \cdot \ell$$

b) Maximum local bending moment, in kN.m

$$M_B = \frac{F \cdot h}{2}$$

where:

τ : Shear stress, in N/mm^2, in way of the window

t : Mean net thickness of the hull girder web, in mm, in way of the window

h : Window height, in m

ℓ : Distance, in m, between centres of two successive windows.

6.1.3 Checking criteria

It is to be checked that the stresses in the window stile are in compliance with [5.4.3].

7 Light facings

7.1 General principles

7.1.1 Facing elements, glazed frames, joinery works, doors may be formed from aluminium alloy sections with suitable surface protection.

7.1.2 Attachment of facing sections

The attachment of facing sections are to be designed so as to:

- ensure the stability of constituent parts under the various service loads
- withstand thermal expansion stress
- allow multi-directional movements of the structure and take-up of manufacturing tolerances
- Permit the renewal of one or more sections without affecting other facing sections
- withstand destructive agents (e.g., corrosion)
- withstand vibration effects.

7.1.3 Tightness

Taking into account the dimensional variations of constituent materials and the overall deformations of the structure, facing setions and seals (except gaskets or seals of mobile parts of structures and ventilation systems) are to provide suitable tigtness against water, air and wind, dust, snow and insects between the outside and the inside of the unit.

7.1.4 Stability under cold and heat

The various facing materials are not to be damaged or deformed permanently by cold or heat.

7.1.5 Physico-chemical stability

All the materials used for facing are to be resistant to corrosion.

Except for materials or parts which can be renewed easily, such renewal being considered as normal maintenance, all constituent materials of light facing are to retain their qualities throughout the life-span of the unit.

7.1.6 Protection against lighting

Arrangements are to be made to prevent the accumulation of static electricity in light facings: metallic skeleton framework and covering, which are continuous over the whole height of the unit, are to be earthed.

7.1.7 Fire safety

See Pt C, Ch 3, Sec 7.

7.1.8 Acoustic comfort

acoustic comfort: depending on the intended purpose and lay-out of the premises, the light facings may have to contribute to the acoustic comfort (see also Pt D, Ch 2, Sec 1, for units assigned the additional class notation **FE-COMF(N-V)**).

7.1.9 Doors

Doors are to open to the outside. Single or double leaf doors may be used.

7.2 Documents to be submitted

7.2.1 The documents listed below are to be submitted, in triplicate, for review/approval:

- Detailed drawings of front facings
- Calculation notes (connections, structural elements of facings)
- Test reports about facing elements
- Other documents such as labels/descriptions, technical notices, technical specifications, etc.

7.2.2 Documents to be submitted for information

The following detailed drawings are to be submitted, in duplicate, for information:

- drawings of the various elements (typical current elements, doors)
- drawings of the various horizontal and vertical connections between panels
- drawings of the attachment and fixings of the panels to the structure
- drawings of the markings of the facing elements, in particular, to allow checks for safety requirements on falls, impacts, etc.
- drawings of elements ensuring watertightness between roof and facing
- drawings of railings and balustrades.

7.3 Design and arrangement

7.3.1 The design and arrangement of light facings are to be performed according to recognised land-based building standards.

8 Internal partition walls and ceilings

8.1 General principles

8.1.1 Internal partition does not include transverse and longitudinal bulkheads ensuring general stability and fixing of the superstructures to the strength deck, which are to comply with [4].

8.1.2 The choice of the various components of internal partition walls and ceilings is to take into account the following:

- mechanical stability, notably, as regards:

  - resistance to chocks

  - resistance to eccentric loads

  - resistance to shearing force.

- fire stability: depending on the intended purpose of the rooms, the partition walls and ceilings are to ensure or , at least, participate in fire stability (see Pt C, Ch 3, Sec 7)
- acoustic comfort: depending on the intended purpose and lay-out of the premises, the partition walls and ceilings may have to contribute to the acoustic comfort (see also Pt D, Ch 2, Sec 1 , for units assigned the additional class notation **FE-COMF(N-V)**).

8.2 Documents to be submitted

8.2.1 The following documents are to be submitted, in triplicate, for review/approval:

- Descriptive note stating:

  - the composition (nature, make and thickness or characteristics of the various materials) of bulkheads and ceiling (facings and frame)

  - the principle of construction and assembly, especially, the type of structural connections between bulkheads, ceilings, etc.

- Lay-out drawings.

8.2.2 Documents to be submitted for information

The following documents are to be submitted, in duplicate, for information:

- Detailed descriptive documents giving, e.g.:

  - the number and thickness of boards

  - the framework type and dimensions

  - assembly

  - treatment of specific points such as connections of partition walls/ceiling, partition walls/structure, ceiling/structure

- Drawings including:

  - lay-out of partition walls and ceilings

  - cross sections of a partition (insulation, separation, cable tray)

  - diagram showing the various connections partion walls/ceiling, partition walls/structure, ceiling/structure.

- Tests reports on mechanical behaviour of eventual special assemblies designed and fitted to withstand stresses during towing or positioning of the unit.

8.3 Design and arrangement

8.3.1 The design and arrangement of internal partition walls and ceilings are to be performed according to recognised land-based building standards.

9 Roofs

9.1 General principles

9.1.1 Basically, the flat roofs are to comprise the following elements:

- bearing elements: ribbed metal plates of galvanised steel, 0,75 mm thick, at least
- insulation
- waterproof coating.

9.2 Documents to be submitted

9.2.1 A description note, stating the following, is to be submitted in triplicate for review/approval:

- the composition of the bulkheads (nature, make and thickness or characteristics of the various materials), span fittings
- drawings of roofs, sections and sketches of details.

9.2.2 Documents to be submitted for information

The following documents are to be submitted, in duplicate, for information:

- technical data sheets and approvals or technical notices for unconventional materials
- details of roofing (expansion joints, pipe-runs, lighting framework, beams, etc.)

9.3 Design and arrangement

9.3.1 The design and arrangement of roofs are to be performed according to recognised land-based building standards.

SECTION 3 HULL INTEGRITY

Symbols

z_{hc} : Z co-ordinate, in m, of the top of hatch coaming

z_{LE} : Z co-ordinate, in m, of the lower edge of opening.

1 River chests

1.1 Shell plating

1.1.1 The shell plate gross thickness, in mm, in way of river chests as well as the gross thickness of all boundary walls of the river chests are not to be less than:

$$t = 1,2s\sqrt{kp} + 1,5$$

where:

p : Pressure at the safety relief valve, in kN/m²:

- in general: $p \geq 200$ kN/m²
- for river chests without any compressed air connection and which are accessible at any time: $p \geq 100$ kN/m²

1.2 Stiffeners

1.2.1 The gross section modulus, in cm3, of river chest stiffeners is not to be less than:

$$w = 0,66kps\ell^2$$

where:

p : Design pressure, in kN/m², defined in [1.1.1].

2 Side shell openings

2.1 General

2.1.1 Openings in the unit's sides are to be well rounded at the corners and located well clear of superstructure ends or any openings in the deck areas at sides of hatchways.

2.2 Arrangement

2.2.1 Shell plating openings

Openings are to be compensated if their edge is less than 0,25D from the bottom or from the deck and if all these openings are located over 0,25L from either end perpendicular.

Compensation is not required for circular openings having a diameter at most equal to 300 mm.

2.2.2 Openings for water intakes

Openings for water intakes are to be well rounded at the corners and, within 0,6L amidships, located outside the bilge strakes. Where arrangements are such that water intakes are unavoidably located in the curved zone of the bilge strakes, such openings are to be elliptical with the major axis in the longitudinal direction.

2.2.3 Other openings

Other openings are considered by the Society on a case by case basis.

2.2.4 Sheerstrake openings

Circular openings on the sheerstrake need not be compensated where their diameter does not exceed 20% of the sheerstrake minimum width, and where they are located away from openings on deck at the side of hatchways or superstructure ends.

2.3 Strengthening

2.3.1 Openings in [2.2] and, when deemed necessary by the Society, other openings of considerable size, are to be compensated by means of insert plates or doublers sufficiently extended in length. Such compensation is to be partial or total depending on the stresses occurring in the area of the openings.

3 Deck openings

3.1 Openings in the strength deck

3.1.1 Openings in the strength deck are to be kept to a minimum and spaced as far apart from one another and from breaks of effective superstructures as practicable. Openings are to be cut as far as practicable from hatchway corners.

3.1.2 No compensation is required where the openings are:

- circular of less than 350 mm in diameter and at a distance, sufficiently far, from any other opening
- elliptical with the major axis in the longitudinal direction and the ratio of the major to minor axis not less than 2.

3.2 Corners of hatchways

3.2.1 General

Hatchways are to be rounded at their corners. The radius of circular corners is to be not less than:

- 5% of the hatch width, where a continuous longitudinal deck girder is fitted below the hatch coaming
- 8% of the hatch width, where no continuous longitudinal deck girder is fitted below the hatch coaming.

Corner radiusing, in the case of the arrangement of two or more hatchways athwartship, is considered by the Society on a case by case basis.

3.2.2 Elliptical and parabolic corners

Strengthening by insert plates in the central part are, in general, not required in way of corners where the plating cut-out has an elliptical or parabolic profile and the half axis of elliptical openings, or the half lengths of the parabolic arch, are not less than:

- 1/20 of the hatchway width or 600 mm, whichever is the lesser, in the transverse direction
- twice the transverse dimension, in the fore and aft direction.

3.3 Deck strengthening in way of hatch corners

3.3.1 The deck plating where the hatchways form corners, is to be increased by 60% with respect to the adjacent plates. As an alternative, the deck plating may be strengthened by a doubling plate having the same thickness.

A lower thickness may be accepted by the Society on the basis of calculations showing that stresses at hatch corners are lower than permissible values.

3.4 Coamings

3.4.1 The edges of cut-outs are to be carefully rounded.

3.4.2 Extension and strength continuity

The lower part of longitudinal coamings are to extend to the lower edge of the nearest beams to which they are to be efficiently secured.

In case of girders fitted under deck or under beams in the plane of the coaming longitudinal sides, strength continuity is to be ensured by means of suitable shifting. The same applies in case of strengthened beams in the plane of the coaming transverse boundaries.

3.4.3 Vertical brackets or stays

Where necessary, the coaming boundaries are to be stiffened with stays, as mentioned in Ch 2, Sec 8, [1.4].

3.5 Very small hatches

3.5.1 The following requirements apply to very small hatchways with a length and width of not more than 1,2 m.

3.5.2 In the case of very small hatches, no brackets are required.

Small hatch covers are to have strength equivalent to that required for main hatchways. In any case, weathertightness is to be maintained.

3.5.3 Accesses to cofferdams and ballast tanks are to be manholes fitted with weathertight covers fixed with bolts which are sufficiently closely spaced.

3.5.4 Hatchways of special design are considered by the Society on a case by case basis.

4 Sidescuttles, windows and skylights

4.1 General

4.1.1 Application

The requirements in [4.1] and [4.3] apply to sidescuttles and rectangular windows providing light and air, located on exposed hull structures.

4.1.2 Sidescuttle definition

Sidescuttles are round or oval openings with an area not exceeding 0,16 m^2. Round or oval openings having areas exceeding 0,16 m^2 are to be treated as windows.

4.1.3 Window definition

Windows are rectangular openings generally, having a radius at each corner relative to the window size in accordance with recognised national or international standards, and round or oval openings with an area exceeding 0,16 m^2.

4.1.4 Number of openings in the shell plating

The number of openings in the shell plating are to be reduced to the minimum compatible with the design and proper working of the unit.

4.2 Watertight sidescuttles and windows

4.2.1 General

Windows and sidescuttles may be situated below the bulkhead deck if they are watertight and comply with [4.3].

4.2.2 Sidescuttles

The construction and strength of sidescuttles fitted below te bulkhead deck are to be in compliance with ISO 1751:04/94, or equivalent standards.

4.2.3 Windows

The construction and strength of windows fitted below the bulkhead deck are to be in compliance with ISO 3903:04/94, or equivalent standards.

4.3 Glasses

4.3.1 General

In general, toughened glasses or laminated glasses with frames of special type are to be used in compliance with, or equivalent to, recognised national or international standards.

The use of clear plate glasses is considered by the Society on a case by case basis.

4.3.2 Design loads

The design load is to be determined in accordance with the applicable requirements of Ch 3, Sec 3, [1], or Ch 6, Sec 2, [3].

4.3.3 Scantling

The windows and sidescuttles scantling defined in this sub-article are equivalent to Standard ISO 21005/2004.

Window scantling defined in this Sub-article are provided for the following types of window:

- monolithic window (see [4.3.4])
- laminated window (see [4.3.5])
- double windows unit with gap (see [4.3.6]).

The edge condition of window and sidescuttle are considered as supported.

4.3.4 Thickness of monolithic windows

The thicknesses, in mm, of monolithic windows and sidescuttles are not to be less than 6 mm nor than the values obtained from the following formulae:

- rectangular window or sidescuttle:

$$t = 27,4s\sqrt{\frac{\beta p S_f}{R_m}}$$

- circular window or sidescuttle:

$$t = 17,4d\sqrt{\frac{p S_f}{R_m}}$$

where:

s : Shorter side, in m, of rectangular window or sidescuttle

ℓ : Longer side, in m, of rectangular window or sidescuttle

d : Diameter, in m, of circular window or sidescuttle

R_m : Guaranteed minimum flexural strength, in N/mm², of material used. For guidance only, the guaranteed minimum flexural strength R_m for glass window is:

- for glass thermally tempering (toughened):
  R_m = 180 N/mm²
- for glass chemically toughened:
  R_m = 250 N/mm²

S_f : Safety factor equal to 5,0

β : Aspect ratio coefficient of the rectangular window or sidescuttle, defined in Tab 1.

Table 1 : Coefficient β

ℓ/s	β
1,0	0,284
1,5	0,475
2,0	0,608
2,5	0,684
3,0	0,716
3,5	0,734
≥ 4,0	0,750

4.3.5 Thickness of laminated windows

Laminated windows are glass windows realized by placing a layer of resin (polyvinyle butyral as a general rule) between two sheets of glass.

The thickness of laminated window is to be calculated as defined in [4.3.4], considering the total thickness of the laminated window as a monolithic window.

4.3.6 Thickness of double windows

Double windows are glass windows realized by two sheets of glass, separated by a spacebar hermetically sealed.

The thickness of the outside glass exposed to loads is to be calculated as defined in [4.3.4].

4.3.7 Thickness of glasses forming screen bulkheads or internal boundaries of superstructures

The thickness of glasses forming screen bulkheads on the side of enclosed promenade spaces and that for rectangular windows in the internal boundaries of superstructures which are protected by such screen bulkheads are considered by the Society on a case by case basis.

The Society may require both limitations on the size of rectangular windows and the use of glasses of increased thickness in way of bulkheads which are particularly exposed.

4.3.8 Manholes and flush scuttles

Manholes exposed to the weather are to be closed by substantial covers capable of being made watertight. Unless secured by closely spaced bolts, the covers are to be permanently attached.

5 Scuppers and discharges

5.1 Material

5.1.1 The scuppers and discharge pipes are to be constructed of steel. Other equivalent materials are considered by the Society on a case by case basis.

5.2 Wall thickness

5.2.1 The wall gross thickness of scuppers and discharge pipes is to be not less than the shell plating thickness in way of the scuppers, respectively discharge pipes, but need not exceed 8 mm.

6 Machinery space openings

6.1 Skylight hatches

6.1.1 Machinery space skylights are to be fitted with weathertight hatches made of steel or any other equivalent material. The hatches are to be permanently secured to the sides where the lower edge of the opening is at a height above the load waterline of less 0,5 m.

6.2 Closing devices

6.2.1 Openings in machinery space casings are to be surrounded by a steel casing of efficient construction. The openings of the casings exposed to the weather are to be fitted with strong and weathertight doors.

6.3 Position of openings

6.3.1 In any case, the distance, in m, of the lower edge of an opening to the load waterline is to be such that:

$z_{LE} \geq T + 0,3$

6.4 Entrances

6.4.1 The height, in m, of entrances to machinery space, h_C, above the deck is not to be less than 0,3 m.

Furthermore, this height h_c , above the deck, is to be such that:

$z_{hc} \geq T + 0,45$

7 Ventilators

7.1 General

7.1.1 Ventilator openings below main deck are to have coamings of steel or other equivalent material, substantially constructed and efficiently connected to the deck.

7.1.2 Coamings

The coaming height above the deck is not to be less than 0,30 m and this height is to be such that:

$z_{hc} \geq T + 0,45$.

Part B

Hull and Stability

Chapter 7

HULL OUTFITTINGS

SECTION 1 BULWARKS AND GUARD RAILS

Symbols

L : Rule length, in m, defined in Ch 1, Sec 2, [1.1]

R_{eH} : Minimum yielding stress, in N/mm²

1 General

1.1

1.1.1 The requirements of this Section apply to the arrangement and scantling of bulwarks and guard rails provided at the boundaries of decks and work stations.

1.1.2 Requirements other than those set out in this Section may be called for by national or international authorities, in order to allow the persons to move about under adequate safety conditions.

1.2 Guard rails

1.2.1 Guard rails are to be at least 1000 mm high above the decks open to public.

The foot-guard is to rise at least 50 mm above the weather deck.

The opening below the lower course is not to be greater than 230 mm. The other courses are not to be more than 380 mm apart.

The scantlings of guard rails are to be in compliance with European standard EN 711:1995 or equivalent standards.

1.3 Bulwarks

1.3.1 General

Where fitted, the bulwarks are to be at least 1000 mm high above the decks open to public.

As a rule, plate bulwarks are to be stiffened at the upper edge by a suitable bar and supported either by stays or plate brackets spaced not more than 2 m apart.

Bulwark stays are to be aligned with the beams located below or are to be connected to them by means of local transverse stiffeners.

As an alternative, the lower end of the stay may be supported by a longitudinal stiffener.

Where bulwarks are cut completely, the scantlings of stays or brackets are to be increased with respect to those given in [1.3.3].

1.3.2 Plating thickness

The bulwark thickness, in mm, is not to be less than:

$t = 4$, for $L \leq 30$ m

$t = 5$, for $30 \text{ m} < L \leq 90$ m

$t = 6$, for $L > 90$ m.

1.3.3 Scantlings of stays

The gross section modulus of stays in way of the lower part of the bulwark is to be not less than the value obtained, in cm³, from the following formula:

$$w = 40\, s\, (1 + 0{,}01\, L_S)\, h^2_B$$

where:

L_S : Length, in m, defined as:

$L_S = \text{Min}(L, 100)$

s : Spacing of stays, in m

h_B : Height of bulwark, in m, measured between its upper edge and the deck.

The actual section of the connection between stays and deck structures is to be taken into account when calculating the above section modulus.

SECTION 2 RAMPS

1 General

1.1

1.1.1 Materials

The ramps are to be made of steel or aluminium alloys complying with the requirements of Ch 2, Sec 3. Other materials of equivalent strength may be used, subject to a case by case examination by the Society.

1.1.2 Net scantlings

As specified in Ch 2, Sec 4, [2], all scantlings referred to in this Article are net, i.e. they do not include any margin for corrosion.

The gross scantlings are to be obtained as specified in Ch 2, Sec 4, [2].

1.1.3 The ramps are to be able to operate with a heel angle of 5° and a trim angle of 2°.

1.1.4 The ramps are to be examined for their watertightness, if applicable.

1.1.5 Minimum plating net thicknesses

The plating net thickness of the ramp structural members is to be not less than the values given in Tab 1.

Table 1 : Minimum net thickness of plating (in mm)

Structural element	Minimum net thickness
Ramp plating	
• longitudinal framing	$0,57 + 0,031\ L\ k^{1/2} + 3,6\ s$
• transverse framing	$0,9 + 0,034\ L\ k^{1/2} + 3,6\ s$
Ordinary stiffeners	
• $L < 120$ m	$1,63 + 0,004\ L\ k^{1/2} + 4,5\ s$
• $L \geq 120$ m	$3,9\ k^{1/2} + s$
Primary supporting members	$3,8 + 0,016\ L\ k^{1/2}$

1.1.6 The net scantlings of the ramp structural elements are to comply with [1.2] and/or [1.3], as applicable.

1.1.7 The unit's structure under the reactions due to the ramp is examined by the Society on a case by case basis.

1.1.8 Allowable deflection

The scantlings of main stiffeners and the distribution of supports are to be such that the deflection of the ramp does not exceed 5 mm/m.

1.2 Ramps subjected to lateral pressure

1.2.1 Plating

The net thickness of ramp plating subjected to lateral pressure in service condition is to determined according to Ch 5, Sec 2, [3.1], where the design pressure is to be defined by the designer.

1.2.2 Ordinary stiffeners

The net section modulus and the net shear sectional area of ordinary stiffeners subjected to lateral pressure in service condition are to be determined according to Ch 5, Sec 3, where the design pressure is to be defined by the designer.

1.2.3 Primary supporting members

The supporting structure of ramps is to be verified through direct calculation, considering the ramp loaded in sloped position, supported by hinges at one end and by a deck at the other, with possible intermediate supports, using the design pressure defined by the designer.

1.3 Ramps subjected to wheeled loads

1.3.1 Plating

The net thickness of plate panels subjected to wheeled loads is not to be less than the value obtained from NR217, Pt D, Ch 1, Sec 5, [3.3], where (n_P F) is not to be taken less than 50 kN.

where:

n_P : Number of wheels on the plate panel, taken equal to:
- 1 in the case of a single wheel
- the number of wheels in the case of double or triple wheels

F : Wheeled force, in kN.

1.3.2 Ordinary stiffeners

The net section modulus and the net shear sectional area of ordinary stiffeners subjected to wheeled loads are not to be less than the value obtained from NR217, Pt D, Ch 1, Sec 5, [3.4].

1.3.3 Primary supporting members

a) General

The supporting structure of ramps is to be verified through direct calculation, considering the ramp loaded in sloped position, supported by hinges at one end and by a deck at the other, with possible intermediate supports

b) Loading cases

The scantlings of the structure are to be verified for both following cases:
- loaded ramp under loads according to the load distribution indicated by the Designer

- loaded ramp under uniformly distributed loads corresponding to a pressure, in kN/m², taken equal to:

$$p_1 = \frac{n_V P_V + P_P}{A_P}$$

where:

n_V : Maximum number of vehicles loaded on the ramp

P_V : Weight of a vehicle, in kN

P_P : Weight of the ramp, in kN

A_P : Effective area of the ramp, in m².

c) Lateral pressure

The lateral pressure is constituted by still water pressure determined taking into account [1.1.3].

d) Checking criteria

It is to be checked that the combined stress σ_{VM}, in N/mm², is in compliance with the criteria defined in Ch 5, Sec 4, [4.4.4].

SECTION 3 FOOTBRIDGES

1 General

1.1 Society involvement

1.1.1 The examination of the design, construction and installation of the footbridges as well as the inspections to be carried out by the Surveyors, do not fall within the scope of the classification.

1.2 Design

1.2.1 The footbridges are to be designed in compliance with applicable recognised standards, taking into account the following:

- minimum design vertical load: 3,5 kN/m^2
- minimum design lateral load: 1,5 kN/m^2
- maximum slope: 10%.

1.3 Arrangement

1.3.1 Footbridges are to be anti-slip and fitted with guard rails complying with Ch 7, Sec 1, [1.2].

SECTION 4 MOORING SYSTEM

1 General

1.1 Society involvement

1.1.1 The examination of the design, construction and installation of the mooring system of classed floating establishments as well as the inspections to be carried out by the Surveyors, do not fall within the scope of the classification.

1.1.2 At the request of the Owner, the Building Yard or other Interested Party, the Society may proceed with the certification and inspection in compliance with the Society's Rules or applicable statutory Regulations.

Part B
Hull and Stability

Chapter 8
CONSTRUCTION AND TESTING

SECTION 1 STEEL AND ALUMINIUM

1 General

1.1 General requirements

1.1.1 Characteristics of the materials

The characteristics of the steel or aluminium materials to be used in the construction of floating establishments are to comply with the applicable requirements of NR216 Materials and welding.

Materials with different characteristics may be accepted, provided their specification (manufacture, chemical composition, mechanical properties, welding, etc.) is submitted to the Society for review/approval.

1.1.2 Testing of materials

Materials are to be tested in compliance with the applicable requirements of NR216 Materials and Welding.

1.1.3 Manufacturing processes

Welding and other cold or hot manufacturing processes are to be carried out in compliance with current sound working practice and the applicable requirements of NR216 Materials and Welding:

- parent materials and welding processes are to be within the limits stated for the specified type of material for which they are intended
- specific preheating may be required before welding
- welding or other cold or hot manufacturing processes may be needed to be followed by an adequate heat treatment

The welders hired by the Building Yard are to be duly qualified and their qualification duly checked, according to the requirements of NR216 Materials and Welding.

The welding procedures used for the construction are to be qualified by qualification tests carried out under the Surveyor's supervision, according to the requirements of NR216 Materials and Welding.

1.2 Welding connections for steel

1.2.1 General

The preparation, execution and inspection of welded connections in steel hull structures are to comply with NR217, Pt B, Ch 8, Sec 1.

1.3 Welding and other connections means for aluminium alloys

1.3.1 General

The preparation, execution and inspection of welded connections or riveting connections in aluminium hull structures are to comply with the applicable requirements of NR561, Hull in Aluminium Alloys, Design Principles, Construction and Surveys.

SECTION 2 PROTECTION OF HULL METALLIC STRUCTURES

1 General

1.1 Protection by coating

1.1.1 General

It is the responsibility of the Building Yard and the Owner to choose the coating and have it applied in accordance with the manufacturer's requirements.

1.1.2 Structures to be protected

All areas endangered by corrosion are to be protected by a suitable corrosion protective coating.

All brackish water ballast spaces with boundaries formed by the hull envelope are to have a corrosion protective coating, epoxy or equivalent, applied in accordance with the manufacturer's requirements.

Corrosion protective coating is not required for internal surfaces of spaces intended for the carriage of fuel oil.

Narrow spaces are generally to be filled by an efficient protective product, particularly at the ends of the unit where inspections and maintenance are not easily practicable due to their inaccessibility.

1.2 Protection against galvanic corrosion in tanks

1.2.1 Suitable protection measures shall take place, where the danger of galvanic corrosion exists.

1.2.2 Non-stainless steel is to be electrically insulated from stainless steel or from aluminium alloys.

1.2.3 Where stainless steel or aluminium alloys are fitted in the same tank as non-stainless steel, a protective coating is to cover both materials.

1.3 Protection of decks by wood sheathing

1.3.1 Deck not entirely plated

The wood used for sheathing is to be of good quality dry teak or pine, without sapwood or knots. The sheathing thickness is not to be less than:

- teak $t = (L + 55) / 3 \geq 40$
- pine $t = (L + 100) / 3$

The width of the planks is not to exceed twice their thickness. Their butts are to be adequately shifted so that, if two butts occur in the same frame spacing, they are separated by at least three planks.

Planks are to be secured to every other frame by means of 12 mm bolts. On small units, galvanized steel screws are permitted.

Wooden decks are to be carefully caulked, to the satisfaction of the Surveyor.

1.3.2 Wood sheathed plate deck

As far as practicable, plate decks above public or crew cabins are to be sheathed with wood planks.

The plank thickness is not to be less than 40 mm nor than:

- teak $t = (L + 40) / 3$
- pine $t = (L + 85) / 3$

SECTION 3 TESTING

1 General

1.1

1.1.1 Application

The following requirements determine the testing conditions for:

- gravity tanks, including independent tanks of 5 m^3 or more in capacity
- watertight or weathertight structures.

The purpose of these tests is to check the tightness and/or the strength of structural elements.

Tests are to be carried out in the presence of the Surveyor at a stage sufficiently close to completion so that any subsequent work would not impair the strength and tightness of the structure.

In particular, tests are to be carried out after air vents and sounding pipes are fitted.

1.1.2 Definitions

a) Symbols

   p : Maximum design pressure, in kPa

   p_{S1} : Leak test pressure, in kPa:

   p_{S1} = MIN (10 ; p)

   p_{S2} : Leak test pressure, in kPa:

   p_{S2} = MIN (15 ; p)

   d_{AP} : Distance from the top of air pipe to the top of the tank, in m.

b) Shop primer

   Shop primer is a thin coating applied after surface preparation and prior to fabrication as a protection against corrosion during fabrication.

c) Protective coating

   Protective coating is a final coating protecting the structure from corrosion.

d) Structural testing

   Structural testing is a hydrostatic test carried out to demonstrate the tightness of the tanks and the structural adequacy of the design. Where practical limitations prevail and hydrostatic testing is not feasible (for example when it is difficult, in practice, to apply the required head at the top of the tank), hydropneumatic testing may be carried out instead.

   Structural testing is to be carried out according to [1.2.2].

e) Hydropneumatic testing

   Hydropneumatic testing is a combination of hydrostatic and air testing, consisting in filling the tank to the top with water and applying an additional air pressure.

   Hydropneumatic testing is to be carried out according to [1.2.3].

f) Leak testing

   Leak testing is an air or other medium test carried out to demonstrate the tightness of the structure.

   Leak testing is to be carried out according to [1.2.4].

g) Hose testing

   Hose testing is carried out to demonstrate the tightness of structural items not subjected to hydrostatic or leak testing and of other components which contribute to the watertight or weathertight integrity of the hull.

   Hose testing is to be carried out according to [1.2.5].

1.2 Watertight compartments

1.2.1 General

The requirements of this Subarticle intend generally to verify the adequacy of the structural design of gravity tanks, excluding independent tanks of less than 5 m^3 in capacity, based on the loading conditions which prevailed when determining the tank structure scantlings.

General requirements for testing of watertight compartments are given in Tab 1, in which the types of testing referred to are defined in [1.1.2].

1.2.2 Structural testing

Structural testing may be carried out before or after launching.

Structural testing may be carried out after application of the shop primer.

Structural testing may be carried out after the protective coating has been applied, provided that one of the following two conditions is satisfied:

- all the welds are completed and carefully inspected visually to the satisfaction of the Surveyor prior to the application of the protective coating
- leak testing is carried out prior to the application of the protective coating.

In the absence of leak testing, protective coating is to be applied after the structural testing of:

- all erection welds, both manual and automatic
- all manual fillet weld connections on tank boundaries and manual penetration welds.

Table 1 : Watertight compartments - General testing requirements

Compartment or structure to be tested	Type of testing	Structural test pressure	Remarks
Double bottom tanks	Structural testing **(1)**	Head of water up to the top of overflow, at least 1, 0 m above tank top	Tank boundaries tested from at least one side
Double side tanks	Structural testing **(1)**	Head of water up to the top of overflow, at least 1, 0 m above tank top	Tank boundaries tested from at least one side
Tank bulkheads, deep tanks	Structural testing **(1)**	The greater of the following **(2)**: • head of water up to the top of overflow, at least 1, 0 m above tank top • testing pressure defined in Ch 3, Sec 3, [3]	Tank boundaries tested from at least one side
Fuel oil bunkers	Structural testing		
Peaks used as tanks	Structural testing	head of water not less than 1, 0 m above tank top	
Peak not used as tank	Structural testing	Head of water up to bulkhead deck	
Cofferdams	Structural testing **(3)**	head of water to be taken at least 1, 0 m above cofferdam top	
Watertight bulkheads	Hose testing **(4)**		
Watertight doors below freeboard or bulkhead deck **(5)**	Structural testing	Head of water up to the bulkhead deck	Test to be carried out before the unit is put into service, either before or after the door is fitted on board
Shell doors	Hose testing		
Weathertight hatch covers and closing appliances	Hose testing		
Independent tanks	Structural testing	Head of water up to the top of overflow, but not less than d_{AP}	

(1) Hydropneumatic or leak testing may be accepted under the conditions specified in [1.2.3] and [1.2.4].
(2) Where applicable, the highest point of the tank is to be measured to deck and excluding hatches. In ballast tanks with large hatch covers, the highest point of tanks is to be taken at the top of the hatch.
(3) Hydropneumatic or leak testing may be accepted under the conditions specified in [1.2.3] and [1.2.4], respectively, when, at the Society's discretion, it is considered significant also in relation to the construction techniques and the welding procedures adopted.
(4) When a hose test cannot be performed without damaging possible outfitting (machinery, cables, switchboards, insulation, etc...) already installed, it may be replaced, at the Society's discretion, by a careful visual inspection of all the crossings and welded joints. Where necessary, a dye penetrant test or ultrasonic leak test may be required.
(5) The means of closure are to be subjected to a hose test after fitting on board.

1.2.3 Hydropneumatic testing

When a hydropneumatic testing is performed, the conditions are to simulate, as far as practicable, the actual loading of the tank.

The value of the additional air pressure is at the discretion of the Society, but is to be at least as defined in [1.2.4] for leak testing.

The same safety precautions as for leak testing (see [1.2.4]) are to be adopted.

1.2.4 Leak testing

An efficient indicating liquid, such as a soapy water solution, is to be applied to the welds.

Where leak testing is carried out in accordance with Tab 1, an air pressure p_{S1} is to be applied during the test.

Prior to inspection, it is recommended that the air pressure in the tank should be raised to p_{S2} and kept at this level for approximately 1 hour to reach a stabilised state, with a minimum number of personnel in the vicinity of the tank, and then lowered to the test pressure.

The test may be conducted after the pressure has reached a stabilised state at p_{S2}, without lowering the pressure, provided the Society is satisfied of the safety of the personnel involved in the test.

A U-tube filled with water up to a height corresponding to the test pressure is to be fitted to avoid overpressure of the compartment tested and to allow verification of the test pressure.

The U-tube is to have a cross-section larger than that of the pipe supplying air.

In addition, the test pressure is also to be verified by means of one master pressure gauge.

Alternative means which are considered to be equivalently reliable may be accepted at the discretion of the Surveyor.

Leak testing is to be carried out, prior to the application of a protective coating, on all fillet weld connections on tank boundaries, and penetration and erection welds on tank boundaries excepting welds made by automatic processes.

Selected locations of automatic erection welds and pre-erection manual or automatic welds may be required to be similarly tested to the satisfaction of the Surveyor, taking into account the quality control procedures operating in the Building Yard.

For other welds, leak testing may be carried out after the protective coating has been applied, provided that such welds have been carefully inspected visually to the satisfaction of the Surveyor.

Any other recognised method may be accepted to the satisfaction of the Surveyor.

1.2.5 Hose testing

When hose testing is required to verify the tightness of the structures, as defined in Tab 1, the minimum pressure in the hose, at least equal to 200 kPa, is to be applied at a maximum distance of 1,5 m.

The nozzle diameter is to be not less than 12 mm.

1.2.6 Other testing methods

Other testing methods may be accepted, at the discretion of the Society, based upon equivalency considerations. As far as applicable, the Society reserves the right, on the request of the Prospective Owner, the Building Yard, or the Other Interested Party, to accept any other equivalent testing methods as defined in other Society's Rules.

Referring to the testing of tanks, this may in particular be effected by a combination of a leak test by means of air pressure and an operational test by means of water or of the liquid for which the tanks are intended to be used. For all tanks the proper functioning of filling and suction lines and of the valves as well as the functioning and tightness of the vent, sounding and overflow pipes is to be tested.

1.3 Doors in bulkheads above the bulkhead deck

1.3.1 Doors are to be designed and constructed as weathertight doors and, after installation, subjected to a hose test from each side for weathertightness.

RULES FOR THE CLASSIFICATION OF FLOATING ESTABLISHMENTS

Part C
Machinery, Systems and Electricity

Chapters 1 2 3

September 2012

Part C
Machinery, Systems and Electricity

Chapter 1
MACHINERY AND SYSTEMS

SECTION 1 GENERAL REQUIREMENTS

1 General

1.1 Application

1.1.1 Part C, Chapter 1 applies to the design, construction, installation, tests and trials of essential auxiliary machinery systems and associated equipment, boilers and pressure vessels and piping systems installed on board classed floating establishments.

1.2 Documentation to be submitted

1.2.1 The drawings and documents requested in the relevant Sections of this Chapter are to be submitted to the Society for review/approval.

1.3 Definitions

1.3.1 Machinery spaces

Machinery spaces are all spaces containing boilers, fuel oil units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

1.3.2 Essential services

Essential services are defined in Pt A, Ch 1, Sec 1, [1.2.5]. They are subdivided in primary and secondary essential services.

1.3.3 Primary essential services

Primary essential services are essential services which need to be in continuous operation to maintain the unit service.

The main lighting system for those parts of the unit normally accessible to and used by public and staff is also considered (included) as a primary essential service.

1.3.4 Secondary essential services

Secondary essential services are those services which need not necessarily be in continuous operation.

Examples of equipment for secondary essential services are the following:

- starting air and control air compressors
- bilge pumps
- fire pumps and other fire-extinguishing medium pumps
- ventilation fans for engine rooms
- internal safety communication equipment
- fire detection and alarm systems
- electrical equipment for watertight closing appliances
- electric generators and associated power supplying the above equipment
- hydraulic pumps supplying the above equipment
- control, monitoring and safety devices/systems for equipment for secondary essential services.

1.3.5 Control station

A control station is a dedicated space or an area of a service space which contains safety and control equpment such as:

- emergency electrical power plant or parts thereof
- control and monitoring equipment for machinery installations
- fire alarm equipment
- remote control of doors or dampers.

A control station shall be installed in a location not accessible to the public and supervised during hours of operation of the floating etablishment.

A control station shall be visible to staff and its controls and signaling shall remain accessible.

2 Design and construction

2.1 General

2.1.1 The machinery, boilers and other pressure vessels, associated piping systems and fittings are to be of a design and construction adequate for the service for which they are intended and are to be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards.

The design is to have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

2.2 Materials, welding and testing

2.2.1 General

Materials, welding and testing procedures are to be in accordance with the requirements of NR216 Materials and Welding and those given in the other Sections of this Chapter. In addition, for machinery components fabricated by welding the requirements given in [2.2.2] apply.

2.2.2 Welded machinery components

Welding processes are to be approved and welders certified by the Society in accordance with NR216 Materials and Welding.

References to welding procedures adopted are to be clearly indicated on the plans submitted for review / approval.

Joints transmitting loads are to be either:

- full penetration butt-joints welded on both sides, except when an equivalent procedure is approved, or
- full penetration T- or cruciform joints.

For joints between plates having a difference in thickness greater than 3 mm, a taper having a length of not less than 4 times the difference in thickness is required. Depending on the type of stress to which the joint is subjected, a taper equal to three times the difference in thickness may be accepted.

T-joints on scalloped edges are not permitted.

Lap-joints and T-joints subjected to tensile stresses are to have a throat size of fillet welds equal to 0,7 times the thickness of the thinner plate on both sides.

In the case of welded structures including cast pieces, the latter are to be cast with appropriate extensions to permit connection, through butt-welded joints, to the surrounding structures, and to allow any radiographic and ultrasonic examinations to be easily carried out.

Where required, preheating and stress relieving treatments are to be performed according to the welding procedure specification.

2.3 Vibrations

2.3.1 Special consideration is to be given to the design, construction and installation of machinery so that any mode of their vibrations is not able to cause undue stresses in this machinery in the normal operating ranges.

2.4 Operation in inclined position

2.4.1 All machinery essential to the safety of the unit are, as fitted in the unit, to be designed to operate when the unit is upright and when it is inclined at any angle of list or trim, as stated in Tab 1.

Machinery with an horizontal rotation axis is generally to be fitted on board with such an axis arranged alongships. If this is not possible, the manufacturer is to be informed at the time the machinery is ordered.

Table 1 : Permanent inclination of unit

Installations, components	Angle of inclination **(1)**	
	List	Trim
Machinery **(2)**	12°	5°
(1) List and trim may occur simultaneously. **(2)** Higher angle values may be required depending on the unit operating conditions.		

2.5 Ambient conditions

2.5.1 Machinery and systems covered by the Rules are to be designed to operate properly under the ambient conditions specified in Tab 2, unless otherwise specified in this Chapter.

Table 2 : Ambient conditions

AIR TEMPERATURE	
Location, arrangement	Temperature range (°C)
In enclosed spaces	between 0 and +40 (+45 in tropical zone) **(1)**
On machinery components, boilers In spaces subject to higher or lower temperatures	According to specific local conditions
On exposed decks	between −20 and +40 (+45 in tropical zone)
(1) Different temperatures may be accepted by the Society in the case of units intended for restricted service.	

WATER TEMPERATURE	
Coolant	Temperature (°C)
River water or, if applicable, river water at charge air coolant inlet	up to +25 in general up to +32 in tropical zone

2.6 Approved fuels

2.6.1 The flash point of liquid fuels for the operation of machinery and boiler installations is to be above 55°C.

2.6.2 Liquid fuel is to be carried in oiltight tanks which either may form part of the hull or is to be solidly connected to the hull.

2.7 Power of machinery

2.7.1 Unless otherwise stated in each Section of this Chapter, where scantlings of components are based on power, the values to be used is the power/rotational speed which is available in service.

2.8 Safety devices

2.8.1 Where risk from overspeeding of machinery exists, means are to be provided to ensure that the safe speed is not exceeded.

2.8.2 Where machinery, including pressure vessels or any parts of such machinery, is subject to internal pressure and may be subject to dangerous overpressure, means are to be provided, where practicable, to protect against such an excessive pressure.

2.8.3 Machinery is to be provided with automatic shut-off arrangements in the case of failures, such as lubricating oil supply failure, which could lead rapidly to complete breakdown, serious damage or explosion.

The Society may permit provisions for overriding automatic shut-off devices.

3 Arrangement and installation on board

3.1 General

3.1.1 Provision is to be made to facilitate cleaning, inspection and maintenance of machinery, including boilers and pressure vessels.

Easy access to the various parts of the machinery is to be provided by means of metallic ladders and gratings fitted with strong and safe handrails.

Spaces containing machinery are to be provided with adequate lighting and ventilation.

3.2 Floors

3.2.1 Floor plating and gratings in machinery spaces are to be metallic and divided into easily removable panels.

The floor plating of normal passageways in machinery spaces is to be made of steel.

3.3 Bolting down

3.3.1 Bedplates of machinery are to be securely fixed to the supporting structures by means of foundation bolts which are to be distributed as evenly as practicable and of a sufficient number and size so as to ensure a perfect fit.

Where the bedplates bear directly on the inner bottom plating, the bolts are to be fitted with suitable gaskets so as to ensure a tight fit and to be arranged with their heads within the double bottom.

Continuous contact between bedplates and foundations along the bolting line is to be achieved by means of chocks of suitable thickness, carefully arranged to ensure a complete contact.

3.4 Safety devices on moving parts

3.4.1 Suitable protective devices are to be provided in way of moving parts in order to avoid injuries to personnel.

3.5 Gauges

3.5.1 All gauges are to be grouped, as far as possible, near each manoeuvring position; in any event, they are to be clearly visible.

3.6 Ventilation in machinery spaces

3.6.1 Machinery spaces are to be sufficiently ventilated so as to ensure that when machinery or boilers therein are operating at full power in all weather conditions a sufficient supply of air is maintained to the spaces for the operation of the machinery.

This sufficient amount of air is to be supplied through suitably protected openings arranged in such a way that they can be used in all weather conditions.

Special attention is to be paid both to air delivery and extraction and to air distribution in the various spaces. The quantity and distribution of air are to be such as to satisfy machinery requirements for developing maximum continuous power.

The ventilation is to be so arranged as to prevent any accumulation of flammable gases or vapours.

3.7 Hot surfaces and fire protection

3.7.1 Surfaces having temperature exceeding 60°C and with which the crew are likely to come into contact during operation are to be suitably protected or insulated.

Surfaces of machinery with temperatures above 220°C, e.g. steam, thermal oil and exhaust gas lines, silencers, exhaust gas boilers and turbochargers, are to be effectively insulated with non-combustible material (see Ch 3, Sec 1, [2.6.2] for definition) or equivalently protected to prevent the ignition of combustible materials coming into contact with them. Where the insulation used for this purpose is oil absorbent or may permit the penetration of oil, the insulation is to be encased in steel sheathing or equivalent material.

Fire protection, detection and extinction is to comply with the requirements of Part C, Chapter 3.

4 Tests and trials

4.1 Work tests

4.1.1 Equipment and its components are subjected to work tests which are detailed in the relevant Sections of this Chapter.

Where such tests cannot be performed in the workshop, the Society may allow them to be carried out on board, provided this is judged not to be in contrast either with the general characteristics of the machinery being tested or with particular features of the on-board installation. In such cases, the Surveyor is to be informed in advance and the tests are to be carried out in accordance with the requirements of NR216 Materials and Welding relative to incomplete tests.

All parts of machinery, hydraulic, pneumatic and other systems, as well as their associated fittings which are under internal pressure, are to be subjected to appropriate tests, including a pressure test, before being put into service for the first time, as detailed in the other Sections of this Chapter.

4.2 Tests on board

4.2.1 Trials on board for machinery are detailed in Ch 1, Sec 7.

SECTION 2 DIESEL ENGINES

1 General

1.1 Application

1.1.1 Diesel engines listed below are to be designed, constructed, installed, tested and certified in accordance with the relevant requirements of NR217, Pt C, Ch 1, Sec 2:

a) engines driving electric generators, including emergency generators

b) engines driving other auxiliaries essential for safety and operation, when they develop a power of 110 kW and over.

All other engines are to be designed and constructed according to sound marine practice and delivered with the relevant works' certificate (see NR216 Materials and Welding, Ch 1, Sec 1, [4.2.3]).

2 Installation design

2.1 General

2.1.1 In addition to the requirements of the present Article, those given in Ch 1, Sec 4 are to be satisfied.

Flexible hoses in the fuel and lubricating oil system are to be limited to the minimum and are to be type-approved.

2.2 Fuel oil system

2.2.1 Relief valves discharging back to the suction of the pumps or other equivalent means are to be fitted on the delivery side of the pumps.

All external high pressure fuel delivery lines between the high pressure fuel pumps and fuel injectors are to be protected with a shielded piping system capable of containing fuel from a high pressure line failure.

A shielded pipe incorporates an outer pipe into which the high pressure fuel pipe is placed forming a permanent assembly.

The shielded piping system is to include a means for collection of leakages and arrangements are to be provided for an alarm to be given in the event of a fuel line failure.

If flexible hoses are used for shielding purposes, these are to be approved by the Society.

When, in fuel oil return piping, the pulsation of pressure with peak-to-peak values exceeds 20 bar, shielding of this piping is also required as above.

2.3 Lubricating oil system

2.3.1 Efficient filters are to be fitted in the lubricating oil system when the oil is circulated under pressure.

Relief valves discharging back to the suction of the pumps or other equivalent means are to be fitted on the delivery side of the pumps.

The relief valves may be omitted, provided the filters can withstand the maximum pressure that the pump may develop.

Where necessary, the lubricating oil is to be cooled by means of suitable coolers.

2.4 Charge air system

2.4.1 Requirements relevant to design, construction, arrangement, installation, tests and certification of exhaust gas turbochargers are to comply with NR217, Pt C, Ch 1, Sec 14.

2.5 Starting systems

2.5.1 Electrical starting

a) Electrical starting arrangements for auxiliary engines are to have two separate storage batteries. In the case of a single auxiliary engine, one battery is acceptable. The combined capacity of the batteries is to be sufficient for at least three starts for each engine.

b) The starting batteries are only to be used for starting and for the engine's alarm and monitoring. Provision is to be made to maintain the stored energy at all times.

c) For rating of each charging device, see Part C, Chapter 2.

2.6 Control and safety devices

2.6.1 Governors for engines driving electric generators

a) Auxiliary engines intended for driving electric generators are to be fitted with a speed governor which prevents any transient speed variations in excess of 10% of the rated speed when the rated power is suddenly thrown off or specific loads are suddenly thrown on.

   In the case when a step load equivalent to the rated output of a generator is switched off, a transient speed variation in excess of 10% of the rated speed may be acceptable, provided this does not cause intervention of the overspeed device as required in [2.6.2].

b) At all loads between no load and rated power, the permanent speed variation is not to be more than 5% of the rated speed.

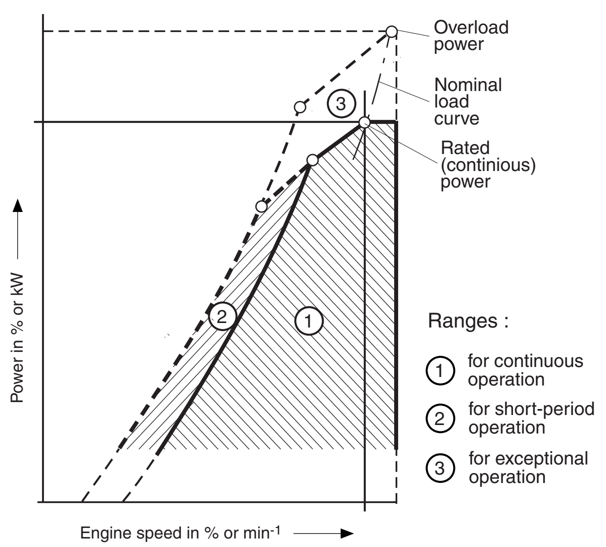
c) Prime movers are to be selected in such a way that they meet the load demand within the unit's mains and, when running at no load, can satisfy the requirement in item a) above if suddenly loaded to 50% of the rated power of the generator, followed by the remaining 50% after an interval sufficient to restore speed to steady state. Steady state conditions (see [2.6.1], Note 1) are to be achieved in not more than 5 s.

d) Application of the electrical load in more than 2 load steps can only be allowed if the conditions within the unit's mains permit the use of those auxiliary engines which can only be loaded in more than 2 load steps (see Fig 1 for guidance) and provided that this is already allowed for in the designing stage.

This is to be verified in the form of system specifications to be approved and to be demonstrated at unit's trials. In this case, due consideration is to be given to the power required for the electrical equipment to be automatically switched on after blackout and to the sequence in which it is connected.

This also applies to generators to be operated in parallel and where the power is to be transferred from one generator to another, in the event that any one generator is to be switched off.

Figure 1 : Limiting curves for loading 4-stroke diesel engines step by step from no load to rated power as a function of the brake mean effective pressure (Mep)



e) When the rated power is suddenly thrown off, steady state conditions should be achieved in not more than 5 s.

f) Emergency generator sets are to satisfy the governor conditions as per items a) and b) when:

- their total consumer load is applied suddenly, or
- their total consumer load is applied in steps, subject to the maximum step load is declared and demonstrated.

g) For alternating current generating sets operating in parallel, the governing characteristics of the prime movers are to be such that, within the limits of 20% and 100% total load, the load on any generating set is, normally, not to differ from its proportionate share of the total load by more than 15% of the rated power in kW of the largest machine or 25% of the rated power in kW of the individual machine in question, whichever is the lesser.

For alternating current generating sets intended to operate in parallel, facilities are to be provided to adjust the governor sufficiently finely to permit an adjustment of load not exceeding 5% of the rated load at normal frequency.

Note 1: Steady state conditions are those at which the envelope of speed variations does not exceed ± 1% of the declared speed at the new power.

2.6.2 Overspeed protective devices of engines driving electric generators

In addition to the speed governor, auxiliary engines of rated power equal to or greater than 220 kW driving electric generators are to be fitted with a separate overspeed protective device, with a means for manual tripping, adjusted so as to prevent the rated speed from being exceeded by more than 15%.

This device is to automatically shut down the engine.

2.6.3 Use of electronic governors

a) Type approval

Electronic governors and their actuators are to be type-approved by the Society.

b) Electronic governors for auxiliary engines driving electric generators

In the event of a fault in the electronic governor system, the fuel admission is to be set to "zero".

Alarms are to be fitted to indicate faults in the governor system.

The acceptance of electronic governors fitted on engines driving emergency generators is to be considered by the Society on a case-by-case basis.

2.7 Control and monitoring

2.7.1 Diesel engines are to be equipped with monitoring equipment in compliance with Ch 2, Sec 12.

2.7.2 Instruments or equivalent devices mounted in a logical manner on the engine are to indicate, at least, the:

- engine speed
- lubricating oil pressure
- cooling water pressure
- cooling water temperature.

In addition, engines above 50 kW in power are to be equipped with an engine alarm system responding to the lubricating oil pressure and to the pressure or flow rate of the cooling water or a failure of the cooling fan, as applicable.

SECTION 3 ARRANGEMENT AND INSTALLATION OF PIPING SYSTEMS

1 General

1.1 Scope and application

1.1.1 This Section applies to arrangement and installation of piping systems, including valves, fittings and pumps, which are necessary for the operation of the on-board machinery and equipment. It also applies to piping systems used in the operation of the unit whose failure could directly or indirectly impair the safety of the unit or persons, and to piping systems which are dealt with in other Sections of the Rules.

1.1.2 General requirements applying to all piping systems are contained in Articles:

- [2] for their design and construction
- [3] for the welding of steel pipes
- [4] for the bending of pipes
- [5] for their arrangement and installation
- [6] for their certification, inspection and testing.

1.2 Documentation to be submitted

1.2.1 Documents

The documents listed in Tab 1 are to be submitted.

1.2.2 Additional information

The documents listed in Tab 2 are also to be submitted.

1.3 Definitions

1.3.1 Piping and piping systems

a) Piping includes pipes and their connections, flexible hoses and expansion joints, valves and their actuating systems, other accessories (filters, level gauges, etc.) and pump casings.

b) Piping systems include piping and all the interfacing equipment such as tanks, pressure vessels, heat exchangers, pumps and centrifugal purifiers, but do not include boilers, turbines and internal combustion engines.

Table 1 : Documents to be submitted

Item No	I/A **(1)**	Document **(2)**
1	A	Drawing showing the arrangement of the river chests and unit side valves
2	A	Diagram of the bilge and ballast systems (in and outside machinery spaces), including calculation for the bilge main, bilge branch lines and bilge pumps capacity as per Rule requirements
3	A	Specification of the central priming system intended for bilge pumps, when provided
4	A	Diagram of the scuppers and sanitary discharge systems
5	A	Diagram of the air, sounding and overflow systems
6	A	Diagram of cooling systems (river water and fresh water)
7	A	Diagram of fuel oil system
8	A	Drawings of the fuel oil tanks not forming part of the unit's structure
9	A	Diagram of the lubricating oil system
10	A	Diagram of the hydraulic systems intended for essential services or located in machinery spaces
11	A	Diagram of the hydraulic and pneumatic remote control systems
12	A	Diagram of the remote level gauging system
13	A	Diagram of the exhaust gas system
14	A	Diagram of drip trays and gutterway draining system
15	A	Arrangement of the ventilation system
16	A	Drawings and specification of valves and accessories

(1) A = to be submitted for review/approval.
I = to be submitted for information.
(2) Diagrams are also to include, where applicable, the (local and remote) control and monitoring systems and automation systems.

Table 2 : Additional documents to be submitted

Item No	I/A (1)	Document
1	I	Nature, service temperature and pressure of the fluids
2	A	Material, external diameter and wall thickness of the pipes
3	A	Type of the connections between pipe lengths, including details of the weldings, where provided
4	A	Material, type and size of the accessories
5	A	Capacity, prime mover and, when requested, location of the pumps
6	A	Constructional drawings of independent tanks showing the height of the overflow and air pipe above the tank top
7	A	For plastic pipes: • the chemical composition • the physical and mechanical characteristics in function of temperature • the characteristics of inflammability and fire resistance • the resistance to the products intended to be conveyed
(1) A = to be submitted for review/approval. I = to be submitted for information.		

1.3.2 Pressures

a) Maximum allowable working pressure PB, in bar (formula symbol: $p_{e,zul}$)

PB is the maximum allowable internal or external working pressure for a component or piping system with regard to the materials used, piping design requirements, the working temperature and undisturbed operation.

b) Nominal pressure PN, in bar

PN is the term applied to a selected pressure temperature relation used for the standardization of structural components. In general, the numerical value of the nominal pressure for a standardized component made of the material specified in the standard is to correspond to the maximum allowable working pressure PB at 20°C.

c) Test pressure PP, in bar (formula symbol: p_p)

PP is the pressure to which components or piping systems are subjected for testing purposes.

d) Design pressure PR, in bar (formula symbol: p_C)

PR is the maximum allowable working pressure PB for which a component or piping system is designed with regard to its mechanical characteristics. In general, the design pressure is the maximum allowable working pressure at which the safety equipment is to interfere (e.g. activation of safety valves, opening of return lines of pumps, operating of overpressure safety arrangements, opening of relief valves) or at which the pumps are to operate against closed valves.

1.3.3 Design temperature

The design temperature of a piping system is the maximum temperature of the medium inside the system.

1.4 Classes of pipes

1.4.1 Pipes are subdivided into two classes, as indicated in Tab 3.

Table 3 : Classification of pipes into "pipe classes"

Medium conveyed by the piping system	Design pressure PR, in bar Design temperature T, in °C	
Toxic media Inflammable media with service temperature above the flash point Inflammable media with a flash point below 60°C Liquefied gases (LPG, LNG, LG) Corrosive media	all	not applicable
Air, gas Lubricating oil, hydraulic oil Boiler feedwater, condensate River water and fresh water for cooling	PR ≤ 40 and T ≤ 300	PR ≤ 16 and T ≤ 200
Liquid fuels	PR ≤ 16 and T ≤ 150	PR ≤ 7 and T ≤ 60
Open-ended pipelines (without shutoff), e.g. drains, venting pipes, overflow lines and boiler blowdown lines	not applicable	all
Pipe class	II	III

2 General requirements for design and construction

2.1 General principles

2.1.1 Piping systems are to be constructed and manufactured on the basis of standards generally used in the unit building.

2.1.2 Welded connections instead of detachable connections should be used for pipelines carrying toxic media and inflammable liquefied gases.

2.1.3 Expansion in piping systems due to heating and shifting of their suspensions caused by deformation of the unit is to be compensated by bends, compensators and flexible pipe connections. The arrangement of suitable fixed points is to be taken into consideration

2.2 Materials

2.2.1 General

Materials are to be suitable for the proposed application and to comply with NR216 Materials and Welding. In the case of especially corrosive media, the Society may impose special requirements on the materials used. For welds, see NR216 Materials and Welding.

2.2.2 Pipes, valves and fittings of steel

Pipes belonging to class II are to be either seamless drawn or produced by a welding procedure approved by the Society.

2.2.3 Pipes, valves and fittings of copper and copper alloys

Pipes of copper and copper alloys are to be of seamless drawn material or produced by a method approved by the Society. Class II copper pipes are to be seamless.

In general, copper and copper alloys pipe lines are not to be used for media having temperatures above the limits given in Tab 4.

Table 4 : Medium limit temperature

Material	Medium limit temperature
Copper and aluminium brass	200°C
Copper nickel alloys	300°C
High-temperature bronze	230°C

2.2.4 Pipes, valves and fittings of cast iron with spheroidal or nodular graphite (GGG)

Pipes, valves and fittings of nodular ferritic cast iron according to the applicable NR216 Materials and Welding may be accepted for bilge, ballast and cargo pipes within double-bottom tanks and cargo tanks and for other purposes approved by the Society, at temperatures up to 350°C.

2.2.5 Pipes, valves and fittings of cast iron with lamellar graphite (grey cast iron) (GG)

Pipes, valves and fittings of grey cast iron may be accepted by the Society for class III. Pipes of grey cast iron may be used for cargo and ballast pipelines within cargo tanks of tankers. Grey cast iron is not allowed for clean ballast lines to forward ballast tanks through cargo oil tanks.

Pipes, valves and fittings of grey cast iron may also be accepted for cargo lines on tankers intended to carry flammable liquids with a flash point ≤ 60°C. Tough materials are to be used for cargo hose connections and distributor headers.

This applies also to the hose connections of fuel and lubricating oil filling lines.

Grey cast iron is not allowed for pipes, valves and fittings for media having temperatures above 220°C and for pipelines subject to water hammer, excessive strains and vibrations.

Grey cast iron is not allowed for river valves and pipes fitted on the unit sides and for valves fitted on the end bulkheads.

Valves on fuel tanks subject to static head may be made of grey cast iron only if they are adequately protected against damage.

The use of grey cast iron for other services is subject to special consideration by the Society.

2.2.6 Plastic pipes

Plastic pipes may be used after special approval by the Society.

Pipes, connecting pieces, valves and fittings made of plastic materials are to be subjected by the manufacturer to a continuous Society-approved quality control.

Pipe penetrations through watertight bulkheads and decks, as well as through fire divisions, are to be approved by the Society. Plastic pipes are to be continuously and permanently marked with the following particulars:

- manufacturer's marking
- standard specification number
- outside diameter and wall thickness of pipe
- year of manufacture.

Valves and connecting pieces made of plastic are, as a minimum requirement, to be marked with the manufacturer's marking and the outside diameter of the pipe.

2.2.7 Aluminium and aluminium alloys

Aluminium and aluminium alloys are to comply with NR216 Materials and Welding and may, in individual cases, with the agreement of the Society, be used for temperatures up to 200°C. They are not acceptable for use in fire-extinguishing lines.

2.2.8 Application of materials

For the pipe classes named in [1.4], materials are to be applied according to Tab 5.

2.3 Pipe minimum wall thickness

2.3.1 The pipe thicknesses given in Tab 6 to Tab 10 are the assigned minimum thicknesses, where:

d_a : Outside diameter of pipe, in mm

t : Wall thickness of pipe, in mm.

Table 5 : Conditions of use of metallic materials

<table>
<tr><th colspan="2" rowspan="2">Material or application</th><th colspan="2">Pipe classes</th></tr>
<tr><th>II</th><th>III</th></tr>
<tr><td rowspan="3">Steel</td><td>Pipes</td><td>Pipes for general applications
Below −10°C, pipes made of steels with high low-temperature toughness
Stainless steel pipes for chemicals</td><td>Steel not subject to any special quality specification, weldability in accordance with NR216 Materials and Welding</td></tr>
<tr><td>Forgings, plates, flanges</td><td colspan="2">Steels suitable for the corresponding loading and processing conditions
Below −10°C, steels with high low-temperature toughness</td></tr>
<tr><td>Bolts, nuts</td><td>Bolts for general machine construction
Below −10°C, steels with high low-temperature toughness</td><td>Bolts for general machine construction</td></tr>
<tr><td rowspan="3">Castings (valves, fittings, pipes)</td><td>Cast steel</td><td>Cast steel for general applications
Below −10°C, cast steel with high low-temperature toughness
For aggressive media stainless castings</td><td>Cast steel for general applications</td></tr>
<tr><td>Spheroidal/Nodular cast iron (GGG)</td><td colspan="2">Only ferritic grades, elongation A5 at least 12%</td></tr>
<tr><td>Cast iron with lamellar graphite (grey cast iron) (GG)</td><td>Not applicable</td><td>At least GG-20 for pipe class III up to 220°C
Not permitted in valves on unit's side, end bulkhead and fuel tanks (1)</td></tr>
<tr><td rowspan="2">Non-ferrous metals (valves, fittings, pipes)</td><td>Copper, copper alloys</td><td>Not applicable</td><td>For river water and alkaline water only, corrosion-resistant copper and copper alloys</td></tr>
<tr><td>Aluminium, aluminium alloy</td><td>Not applicable</td><td>Only with the agreement of the Society, up to 200°C
Not permitted in fire-extinguishing systems</td></tr>
<tr><td>Non-metallic</td><td>Plastics</td><td>Not applicable</td><td>On special approval, see [2.2.6]</td></tr>
<tr><td colspan="4">(1) For valves on fuel tanks, see 6th paragraph of [2.2.5].</td></tr>
</table>

Table 6 : Wall thickness - Steel pipes

d_a (mm)	t mini (mm)	d_a (mm)	t mini (mm)
up to 10,2	1,6	from 114,3	3,2
from 13,5	1,8	from 133,0	3,6
from 20,0	2,0	from 152,4	4,0
from 48,3	2,3	from 177,8	4,5
from 70,0	2,6	from 244,5	5,0
from 88,9	2,9	from 298,5	5,6

Note 1: For systems where carbon dioxide is stored at ambient temperature, see Tab 7.
Note 2: For steel pipes located inside tanks, see also [5.2.3].

Table 7 : Wall thickness - Steel pipes for CO_2 systems

Outside diameter d_a (mm)	t mini (mm)	
	Between bottles and master valves	Between master valves and nozzles
up to 26,9	3,2	2,6
from 48,3	4,0	3,2
from 60,3	4,5	3,6
from 76,1	5,0	3,6
from 88,9	5,6	4,0
from 101,6	6,3	4,0
from 114,3	7,1	4,5
from 127,8	8,0	4,5
from 139,7	8,0	5,0
from 168,3	8,8	5,6

Table 8 : Wall thickness - Copper and copper alloy pipes

Copper pipes		Copper alloy pipes	
d_a (mm)	t mini (mm)	d_a (mm)	t mini (mm)
up to 12,2	1,0	up to 22,0	1,0
from 14,0	1,5	from 25,0	1,5
from 44,5	2,0	from 76,0	2,0
from 60,0	2,5	from 108,0	2,5
from 108,0	3,0	from 219,0	3,0
from 159,0	3,5		

Table 9 : Wall thickness - Stainless steel pipes

Outside diameter d_a (mm)	t mini (mm)
0 - 50	1,7
54 - 70	2,0
73 -140	2,1
141 -220	2,8
270 -280	3,4
320 -360	4,0
400 - 460	4,2
500 - 560	4,8

Note 1: A different thickness may be considered by the Society on a case-by-case basis, provided that it complies with recognised standards.

Table 10 : Wall thickness - Aluminium and aluminium alloy pipes

Outside diameter d_a (mm)	t mini (mm)
0 - 10	1,5
12 - 38	2,0
43 - 57	2,5
76 - 89	3,0
108 - 133	4,0
159 - 194	4,5
219 - 273	5,0
above 273	5,5
Note 1: A different thickness may be considered by the Society on a case-by-case basis, provided that it complies with recognised standards. **Note 2:** For river water pipes, the minimum thickness is not to be less than 5 mm.	

2.4 Thickness of pressure piping

2.4.1 Calculation of the thickness of pressure pipes

a) The thickness t, in mm, of pressure pipes is to be determined by the following formula but, in any case, is not to be less than the minimum thickness given in Tab 6 to Tab 10.

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}}$$

where:

t_0 : Coefficient, in mm, equal to:

$$t_0 = \frac{p_C \cdot d_a}{0,2Ke + p_C}$$

with:

p_C : Design pressure, in bar, defined in [1.3.2]

d_a : Pipe external diameter, in mm

K : Permissible stress, in N/mm², defined in [2.4.2]

e : Weld efficiency factor:

- e = 1 for seamless pipes and pipes fabricated according to a welding procedure approved by the Society
- e is specially considered by the Society for other welded pipes, depending on the service and the manufacture procedure

b : Thickness reduction due to bending, in mm, defined in [2.4.3]

c : Corrosion allowance, in mm, defined in [2.4.4]

a : Negative manufacturing tolerance percentage:

- a = 10 for copper and copper alloy pipes, cold drawn seamless steel pipes and steel pipes fabricated according to a welding procedure approved by the Society
- a = 12,5 for hot laminated seamless steel pipes
- a is subject to special consideration by the Society in the other cases.

b) The thickness thus determined does not take into account the particular loads to which pipes may be subjected. Attention is to be drawn, in particular, to the case of high temperature and low temperature pipes.

2.4.2 Permissible stress

a) The permissible stress K, in N/mm², is given in:

- Tab 11 for carbon and carbon-manganese steel pipes
- Tab 12 for alloy steel pipes, and
- Tab 13 for copper and copper alloy pipes,

as a function of the temperature. Intermediate values may be obtained by interpolation.

b) Where, for carbon steel and alloy steel pipes, the value of the permissible stress K is not given in Tab 11 or Tab 12, it is to be taken equal to the lowest of the following values:

$$\frac{R_{m,20}}{2,7} \qquad \frac{R_e}{A} \qquad \frac{\sigma_R}{A} \qquad \sigma$$

where:

$R_{m,20}$: Minimum tensile strength of the material at ambient temperature (20°C), in N/mm²

R_e : Minimum yield strength or 0,2% proof stress at the design temperature, in N/mm²

σ_R : Average stress to produce rupture in 100000 h at design temperature, in N/mm²

σ : Average stress to produce 1% creep in 100000 h at design temperature, in N/mm²

A : Safety factor, to be taken equal to:

- 1,6 when R_e and s_R values result from tests attended by the Society
- 1,8 otherwise.

c) The permissible stress values adopted for materials other than carbon steel, alloy steel, copper and copper alloy are specially considered by the Society.

Table 11 : Permissible stresses for carbon and carbon-manganese steel pipes

Specified minimum tensile strength (N/mm^2)	Design temperature (°C)												
	≤50	100	150	200	250	300	350	400	410	420	430	440	450
	Permissible stress K, in N/mm^2												
320	107	105	99	92	78	62	57	55	55	54	54	54	49
360	120	117	110	103	91	76	69	68	68	68	64	56	49
410	136	131	124	117	106	93	86	84	79	71	64	56	49
460	151	146	139	132	122	111	101	99	98	85	73	62	53
490	160	156	148	141	131	121	111	109	98	85	73	62	53

Table 12 : Permissible stresses for alloy steel pipes

Type of steel	Specified minimum tensile strength (N/mm^2)	Design temperature (°C)									
		≤ 50	100	200	300	350	400	440	450	460	470
		Permissible stress K, in N/mm^2									
1Cr1/2Mo	440	159	150	137	114	106	102	101	101	100	99
2 1/4Cr1Mo annealed	410	76	67	57	50	47	45	44	43	43	44
2 1/4Cr1Mo normalised and tempered below 750°C	490	167	163	153	144	140	136	130	128	127	116
2 1/4Cr1Mo normalised and tempered above 750°C	490	167	163	153	144	140	136	130	122	114	105
1/2Cr 1/2Mo 1/4V	460	166	162	147	120	115	111	106	105	103	102

Type of steel	Specified minimum tensile strength (N/mm^2)	Design temperature (°C)									
		480	490	500	510	520	530	540	550	560	570
		Permissible stress K, in N/mm^2									
1Cr1/2Mo	440	98	97	91	76	62	51	42	34	27	22
2 1/4Cr1Mo annealed	410	42	42	41	41	41	40	40	40	37	32
2 1/4Cr1Mo normalised and tempered below 750°C	490	106	96	86	79	67	58	49	43	37	32
2 1/4Cr1Mo normalised and tempered above 750°C	490	96	88	79	72	64	56	49	43	37	32
1/2Cr 1/2Mo 1/4V	460	101	99	97	94	82	72	62	53	45	37

Table 13 : Permissible stresses for copper and copper alloy pipes

Material (annealed)	Specified minimum tensile strength (N/mm^2)	Design temperature (°C)										
		≤ 50	75	100	125	150	175	200	225	250	275	300
		Permissible stress K, in N/mm^2										
Copper	215	41	41	40	40	34	27,5	18,5				
Aluminium brass	325	78	78	78	78	78	51	24,5				
Copper-nickel 95/5 and 90/10	275	68	68	67	65,5	64	62	59	56	52	48	44
Copper-nickel 70/30	365	81	79	77	75	73	71	69	67	65,5	64	62

2.4.3 Thickness reduction due to bending

a) Unless otherwise justified, the thickness reduction b due to bending is to be determined by the following formula:

$$b = \frac{d_a t_0}{2,5\rho}$$

where:

ρ : Bending radius measured on the centre line of the pipe, in mm

d_a : As defined in [2.4.1]

t_0 : As defined in [2.4.1].

b) When the bending radius is not given, the thickness reduction is to be taken equal to:

$$\frac{t_0}{10}$$

c) For straight pipes, the thickness reduction is to be taken equal to 0.

2.4.4 Corrosion allowance

The values of corrosion allowance c are given in Tab 14 for steel pipes and in Tab 15 for non-ferrous metallic pipes.

Table 14 : Corrosion allowance - Steel pipes

Piping system	c (mm)
Hydraulic oil	0,3
Lubricating oil	0,3
Fuel oil	1,0
Fresh water	0,8
River water	3,0
Note 1: For pipes passing through tanks, an additional corrosion allowance is to be considered in order to account for the external corrosion. **Note 2:** The corrosion allowance of pipes efficiently protected against corrosion may be reduced by no more than 50%. **Note 3:** When the corrosion resistance of alloy steels is adequately demonstrated, the corrosion allowance may be disregarded.	

Table 15 : Corrosion allowance - Non-ferrous metal pipes

Piping material **(1)**	c (mm) **(2)**
Copper	0,8
Brass	0,8
Copper-tin alloys	0,8
Copper-nickel alloys with less than 10% of Ni	0,8
Copper-nickel alloys with at least 10% of Ni	0,5
Aluminium and aluminium alloys	0,5
(1) The corrosion allowance for other materials is specially considered by the Society. Where their resistance to corrosion is adequately demonstrated, the corrosion allowance may be disregarded. **(2)** In cases of media with high corrosive action, a higher corrosion allowance may be required by the Society.	

2.4.5 Tees

As well as complying with the provisions of [2.4.1] to [2.4.4] above, the thickness t_T, in mm, of pipes on which a branch is welded to form a Tee, is not to be less than the value given by the following formula:

$$t_T = \left(1 + \frac{d_1}{d_a}\right) \cdot t_0$$

where:

d_1 : External diameter of the branch pipe, in mm

d_a, t_0 : As defined in [2.4.1].

Note 1: This requirement may be dispensed with for Tees provided with a reinforcement or extruded.

2.5 Pipe connections

2.5.1 Dimensions and calculation

The dimensions of flanges and bolting are to comply with recognized standards.

2.5.2 Pipe connections

The following pipe connections may be used:

- fully penetrating butt welds, with or without provision to improve the quality of the root
- socket welds, with suitable fillet weld thickness and possibly in accordance with recognized standards
- screw connections of approved type.

For the use of these pipe connections, see Tab 16.

Table 16 : Pipe connections

Types of connections	Pipe class	Nominal diameter
Welded butt-joints with special provisions for root side	II, III	all
Welded butt-joints without special provisions for root side	II, III	
Welded sockets	III	
Screwed sockets	see [2.5.2] for subordinate systems	< 50 mm

Screwed socket connections and similar connections are not permitted for pipes of classes II and III. Screwed socket connections are allowed only for subordinate systems (e.g. sanitary and hot-water heating systems) operating at low pressures. Screwed pipe connections and pipe coupling may be used subject to special approval.

Steel flanges may be used considering the allowed pressures and temperatures as stated in the corresponding standards.

Flanges made of non-ferrous metals may be used in accordance with the relevant standards and within the limits laid down in the approvals. Flanges and brazed or welded collars of copper and copper alloys are subject to the following requirements:

a) welding neck flanges: according to standard up to 200°C or 300°C for all pipe classes

b) loose flanges with welding collar: as for item a)

c) plain brazed flanges: only for pipe class III up to a nominal pressure of 16 bar and a temperature of 120°C.

Approved pipe couplings are permitted in the following piping systems outside engine rooms:

- bilge and ballast systems
- fuel and oil systems
- fire-extinguishing and deck-washing systems
- air, filling and sounding pipes
- sanitary drain pipes
- drinking water pipes.

These couplings may be used inside machinery spaces only if they have been approved by the Society as flame-resistant.

The use of pipe couplings is not permitted in bilge lines inside fuel tanks and ballast tanks.

2.6 Hose assemblies and compensators

2.6.1 Scope

The following Rules are applicable for hose assemblies and compensators made of non-metallic and metallic materials.

Hose assemblies and compensators made of non-metallic and metallic materials may be used according to their suitability in fuel-, lubricating oil-, hydraulic oil-, bilge-, ballast-, fresh water cooling-, river water cooling-, compressed air-, auxiliary steam, exhaust gas and thermal oil systems.

2.6.2 Definitions

a) Hose assemblies consist of metallic or non-metallic hoses completed with end fittings ready for installation.

b) Compensators consist of bellows with end fittings as well as anchors for absorption of axial loads where angular or lateral flexibility is to be ensured. End fittings may be flanges, welding ends or approved pipe unions.

c) Burst pressure is the internal static pressure at which a hose assembly or a compensator is destroyed.

d) High pressure hose assemblies and compensators

   Hose assemblies or compensators which are suitable for use in systems with predominant dynamic load characteristics.

e) Low pressure hose assemblies and compensators

   Hose assemblies or compensators which are suitable for use in systems with predominant static load characteristics.

f) Maximum allowable working pressure respectively nominal pressure of hose assemblies and compensators

   The maximum allowable working pressure of high pressure hose assemblies is the maximum dynamic internal pressure permitted to be imposed on the components.

   The maximum allowable working pressure respectively nominal pressure for low pressure hose assemblies and compensators is the maximum static internal pressure permitted to be imposed on the components.

g) Test pressure

   For non-metallic high pressure hose assemblies, the test pressure is 2 times the maximum allowable working pressure.

   For non-metallic low pressure hose assemblies and compensators, the test pressure is 1,5 times the maximum allowable working pressure or 1,5 times the nominal pressure.

   For metallic hose assemblies and compensators, the test pressure is 1,5 times the maximum allowable working pressure or 1,5 times the nominal pressure.

h) Burst pressure

   For non-metallic as well as metallic hose assemblies and compensators, the burst pressure is to be at least 4 times the maximum allowable working pressure or 4 times the nominal pressure. Excepted hereof are non-metallic hose assemblies and compensators with a maximum allowable working pressure or nominal pressure of not more than 20 bar. For such components, the burst pressure is to be at least 3 times the maximum allowable working pressure or 3 times the nominal pressure.

2.6.3 Requirements

a) Hoses and compensators used in the systems mentioned in [2.6.1] are to be of approved type.

b) Manufacturers of hose assemblies and compensators are to be recognized by the Society.

c) Hose assemblies and compensators, including their couplings, are to be suitable for media, pressures and temperatures they are designed for.

d) The selection of hose assemblies and compensators is to be based on the maximum allowable working pressure of the system concerned. A pressure of 5 bar is to be considered as the minimum working pressure.

e) Hose assemblies and compensators for the use in fuel-, lubricating oil-, hydraulic oil-, bilge- and river water systems are to be flame-resistant.

2.6.4 Installations

a) Non-metallic hose assemblies are only to be used at locations where they are required for compensation of relative movements. They are to be kept as short as possible under consideration of the installation instructions of the hose manufacturer.

b) The minimum bending radius of installed hose assemblies is not to be less than the value specified by the manufacturers.

c) Non-metallic hose assemblies and compensators are to be located at visible and accessible positions.

d) In fresh water systems with a working pressure ≤ 5 bar and in charging and scavenging air lines, hoses may be fastened to the pipe ends with double clips.

e) Where hose assemblies and compensators are installed in the vicinity of hot components, they are to be provided with approved heat-resistant sleeves.

2.6.5 Marking

Hose assemblies and compensators are to be permanently marked with the following particulars:

- manufacturer's mark or symbol
- date of manufacturing
- type
- nominal diameter
- maximum allowable working pressure respectively nominal pressure
- test certificate number and sign of the responsible Society inspection.

2.7 Shutoff devices

2.7.1 Shutoff devices are to comply with a recognized standard. Valves with screwed-on covers are to be secured to prevent unintentional loosening of the cover.

2.7.2 Hand-operated shutoff devices are to be closed by turning in the clockwise direction.

2.7.3 Indicators are to be provided showing the open/closed position of valves unless this position is shown by other means.

2.7.4 Change-over devices in piping systems in which a possible intermediate position of the device could be dangerous in service are not to be used.

2.8 Outboard connections

2.8.1 Outboards are to be made of steel or appropriate non-brittle material.

2.8.2 Valves may only be mounted on the unit side by means of reinforcing flanges or thick-walled connecting pipes.

2.8.3 Unit side valves are to be easily accessible. Water inlet and outlet valves are to be capable of being operated from above the floor plates. Cocks on the unit side are to be so arranged that the handle can only be removed when the cock is closed.

2.8.4 Where a discharge pipe is connected to the unit hull below the bulkhead deck, the wall gross thickness of the pipe sections extending between the shell and the nearest shutoff device is to be equal to that of the shell plating in way of the connection, but need not exceed 8 mm.

2.8.5 Outboard connections are to be fitted with shutoff valves.

2.8.6 Scupper pipes and valves are to be connected to the shell by weld flanges. Instead of weld flanges, short-flanged sockets with an adequate thickness may be used if they are welded to the shell in an appropriate manner.

2.9 Remote controlled valves

2.9.1 Scope

These Rules apply to hydraulically, pneumatically or electrically operated valves in piping systems and sanitary discharge pipes.

2.9.2 Construction

Remote controlled bilge valves and valves important to the safety of the unit are to be equipped with an emergency operating arrangement.

2.9.3 Arrangement of valves

The accessibility of the valves for maintenance and repairing is to be taken into consideration.

Valves in bilge lines and sanitary pipes are always to be accessible.

Bilge line valves and control lines are to be located as far as possible from the bottom and sides of the unit.

The requirements stated hereabove also apply here to the location of valves and control lines.

Where remote controlled valves are arranged inside the ballast tanks, the valves are always to be located in the tank adjoining that to which they relate.

Remote-controlled valves mounted on high and wing fuel tanks are to be capable of being closed from outside the compartment in which they are installed.

2.9.4 Control stands

The control devices of remote controlled valves are to be arranged together in one control stand.

The control devices are to be clearly and permanently identified and marked.

It is to be recognized at the control stand whether the valves are open or closed.

In the case of bilge valves and valves for changeable tanks, the closed position is to be indicated by limit-position indicators approved by the Society, as well as by visual indicators at the control stand.

The control stand for remote controlled bilge valves is to be located outside the machinery spaces and above the bulkhead deck.

2.9.5 Power units

Power units are to be equipped with at least two independent sets for supplying power for remote controlled valves.

The energy required for the closing of valves which are not closed by spring power is to be supplied by a pressure accumulator.

Pneumatically operated valves may be supplied with air from the general compressed air system.

Where the quick-closing valves of fuel tanks are closed pneumatically, a separate pressure accumulator is to be provided. This is to be of adequate capacity and located outside the engine room. Filling of this accumulator by a direct connection to the general compressed air system is allowed. A non-return valve is to be arranged in the filling connection of the pressure accumulator.

The accumulator is to be provided either with a pressure control device with a visual and acoustic alarm or with a hand-compressor as a second filling appliance.

The hand-compressor is to be located outside the engine room.

2.9.6 After installation on board, the entire system is to be subjected to an operational test.

2.10 Pumps

2.10.1 Displacement pumps are to be equipped with sufficiently dimensioned relief valves without shutoff to prevent any excessive overpressure in the pump housing.

2.10.2 Rotary pumps are to be capable of being operated without damage even when the delivery line is closed.

2.10.3 Pumps mounted in parallel are to be protected against overloading by means of non-return valves fitted at the outlet side.

2.10.4 Pumps for essential services are subject to adequate pressure and running tests.

2.11 Protection of piping systems against overpressure

2.11.1 The following piping systems are to be fitted with safety valves to avoid unallowable overpressures:

- piping systems and valves in which liquids can be enclosed and heated
- piping systems which may be exposed in service to pressures in excess of the design pressure.

Safety valves are to be capable of discharging the medium at a maximum pressure increase of 10%. Safety valves are to be fitted on the low pressure side of reducing valves.

2.11.2 Air escaping from the pressure-relief valves of the pressurised air tanks installed in the engine rooms is to be led from the pressure-relief valves to the open air.

2.12 Independent tanks

2.12.1 General

These requirements for scantling apply to steel tanks not forming part of the unit structure. Scantling of tanks not made of steel is given special consideration.

The meaning of the symbols used in this sub-article is as follows:

s : Stiffener spacing, in m

p_{ST} : Testing pressure defined in Pt B, Ch 3, Sec 3, [3], to be determined in way of the calculation point (see Pt B, Ch 5, Sec 2, [1.2], for plating, and Pt B, Ch 5, Sec 3, [1.1], for stiffeners)

λ_b :
- for horizontal stiffeners: $\lambda_b = 1,0$
- for the other stiffeners: $\lambda_b = 1,2$

λ_S :
- for horizontal stiffeners: $\lambda_b = 1,0$
- for other stiffeners: $\lambda_b = 1,4$

2.12.2 Net thickness of plating

The net thickness, in mm, of plating of tanks not forming part of the unit structure is not to be less than either t_1 or t_2 derived from the following formulae:

- $t_1 = 2,5$
- $t_2 = s\sqrt{p_{ST}}$

2.12.3 Net section modulus and net shear sectional area

The net section modulus w, in cm³, and the net shear sectional area A_{Sh}, in cm², of tank stiffeners are not to be less than, respectively:

$$w = 0,55\ \lambda_b\ p_{ST}\ s\ \ell^2$$

$$A_{Sh} = 0,045\ \lambda_S\ p_{ST}\ s\ \ell$$

3 Welding of steel piping

3.1 General

3.1.1 Welding of steel pipes is to comply with the applicable requirements of NR467, Pt C, Ch 10.

4 Bending of pipes

4.1 Application

4.1.1 This Article applies to pipes made of:

- alloy or non-alloy steels
- copper and copper alloys.

4.2 Bending process

4.2.1 General

The bending process is to be such as not to have a detrimental influence on the characteristics of the materials or on the strength of the pipes.

4.2.2 Bending radius

Unless otherwise justified, the bending radius measured on the centreline of the pipe is not to be less than:

- twice the external diameter for copper and copper alloy pipes
- 3 times the external diameter for cold bent steel pipes.

4.2.3 Acceptance criteria

a) The pipes are to be bent in such a way that, in each transverse section, the difference between the maximum and minimum diameters after bending does not exceed 10% of the mean diameter; higher values, but not exceeding 15%, may be allowed in the case of pipes not subjected, in service, to appreciable bending stresses due to thermal expansion or contraction.

b) The bending is to be such that the depth of the corrugations is as small as possible and does not exceed 5% of their length.

4.2.4 Hot bending

a) In the case of hot bending, all arrangements are to be made to permit careful checking of the metal temperature and to prevent rapid cooling, especially for alloy steels.

b) Hot bending is to be generally carried out in the temperature range 850°C-1000°C for all steel grades; however, a decreased temperature down to 750°C may be accepted during the forming process.

4.3 Heat treatment after bending

4.3.1 Copper and copper alloy

Copper and copper alloy pipes are to be suitably annealed after cold bending if their external diameter exceeds 50 mm.

4.3.2 Steel

a) After hot bending carried out within the temperature range specified in [4.2.4], the following applies:
   - for C, C-Mn and C-Mo steels, no subsequent heat treatment is required
   - for Cr-Mo and Cr-Mo-V steels, a subsequent stress relieving heat treatment in accordance with Tab 17 is required.

b) After hot bending performed outside the temperature range specified in [4.2.4], a subsequent new heat treatment in accordance with Tab 18 is required for all grades.

c) After cold bending at a radius lower than 4 times the external diameter of the pipe, a heat treatment in accordance with Tab 18 is required.

Table 17 : Heat treatment temperature

Type of steel	Thickness of thicker part (mm)	Stress relief treatment temperature (°C)
C and C-Mn	t ≥ 15 **(1) (3)**	550 to 620
0,3Mo	t ≥ 15 **(1)**	580 to 640
1Cr0,5Mo	t ≥ 8	620 to 680
2,25Cr1Mo 0,5Cr0,5MoV	any **(2)**	650 to 720

(1) Where steels with specified Charpy V-notch impact properties at low temperature are used, the thickness above which post-weld heat treatment is to be applied may be increased, subject to special agreement of the Society.
(2) For 2,25Cr1Mo and 0,5Cr0,5MoV grade steels, heat treatment may be omitted for pipes having thickness lower than 8 mm, diameter not exceeding 100 mm and service temperature not exceeding 450°C.
(3) For C and C-Mn steels, stress relieving heat treatment may be omitted up to 30 mm thickness, subject to special agreement of the Society.

Table 18 : Heat treatment after bending

Type of steel	Heat treatment and temperature (°C)
C and C-Mn	Normalising 880 to 940
0,3Mo	Normalising 900 to 940
1Cr0,5Mo	Normalising 900 to 960 Tempering 640 to 720
2,25Cr1Mo	Normalising 900 to 960 Tempering 650 to 780
0,5Cr-0,5Mo-0,25V	Normalising 930 to 980 Tempering 670 to 720

5 Arrangement and installation of piping systems

5.1 General

5.1.1 Unless otherwise specified, piping and pumping systems covered by the Rules are to be permanently fixed on board.

5.1.2 Piping systems are to be adequately identified according to their purpose. Valves are to be permanently and clearly marked.

5.1.3 Piping systems are to be so arranged that they can be completely emptied, drained and vented. Piping systems in which the accumulation of liquids during operation could cause damage are to be equipped with special drain arrangements.

5.2 Location of tanks and piping system components

5.2.1 Flammable oil systems

Location of tanks and piping system components conveying flammable fluids under pressure is to comply with [5.9].

5.2.2 Piping systems with open ends

Attention is to be paid to the requirements for the location of open-ended pipes on board units having to comply with the provisions of [5.5].

5.2.3 Pipe lines located inside tanks

a) The passage of pipes through tanks, when permitted, normally requires special arrangements such as reinforced thickness or tunnels, in particular for:
   - bilge pipes
   - ballast pipes
   - scuppers and sanitary discharges
   - air, sounding and overflow pipes
   - fuel oil pipes.

b) Junctions of pipes inside tanks are to be made by welding or flange connections.

5.2.4 Piping and electrical apparatus

As far as possible, pipes are not to pass near switchboards or other electrical apparatus. If this requirement is impossible to satisfy, gutterways or masks are to be provided wherever deemed necessary to prevent projections of liquid or steam on live parts.

5.3 Passage through bulkheads or decks

5.3.1 Penetration of watertight bulkheads or decks and fire divisions

a) Where penetration of watertight bulkheads or decks and fire divisions is necessary for piping and ventilation, arrangements are to be made to maintain the watertight integrity and fire integrity.

b) Lead or other heat sensitive materials are not to be used in piping systems which penetrate watertight subdivision bulkheads or decks, where deterioration of such systems in the event of fire would impair the watertight integrity of the bulkhead or decks.

c) Where bolted connections are used when passing through watertight bulkheads or decks, the bolts are not to be screwed through the plating. Where welded connections are used, they are to be welded on both sides of the bulkhead or deck.

5.4 Independence of lines

5.4.1 As a general rule, bilge and ballast lines are to be entirely independent and distinct from lines conveying lubricating oil and fuel oil, with the exception of:

- pipes located between collecting boxes and pump suctions
- pipes located between pumps and overboard discharges
- pipes supplying compartments likely to be used alternatively for ballast or fuel oil, provided such pipes are fitted with blind flanges or other appropriate change-over devices, in order to avoid any mishandling.

5.5 Prevention of progressive flooding

5.5.1 In order to comply with the subdivision and damage stability requirements, provision is to be made to prevent any progressive flooding of a dry compartment served by any open-ended pipe, in the event that such pipe is damaged or broken in any other compartment by collision.

5.5.2 For this purpose, if pipes are situated within assumed flooded compartments, arrangements are to be made to ensure that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage. However, the Society may permit minor progressive flooding if it is demonstrated that its effects can be easily controlled and the safety of the unit is not impaired.

5.6 Provision for expansion

5.6.1 General

Piping systems are to be so designed and pipes so fixed as to allow for relative movement between pipes and the unit structure, with due regard to the:

- temperature of the fluid conveyed
- coefficient of thermal expansion of the pipe materials
- deformation of the unit hull.

5.6.2 Fitting of expansion devices

All pipes subject to thermal expansion and those which, due to their length, may be affected by deformation of the hull, are to be fitted with expansion pieces or loops.

5.7 Supporting of the pipes

5.7.1 General

Unless otherwise specified, the fluid lines referred to in this Section are to consist of pipes connected to the unit structure by means of collars or similar devices.

5.7.2 Arrangement of supports

Building yards are to take care that:

a) The arrangement of supports and collars is to be such that pipes and flanges are not subjected to abnormal bending stresses, taking into account their own mass, the metal they are made of, and the nature and characteristics of the fluid they convey, as well as the contractions and expansions to which they are subjected.

b) Heavy components in the piping system, such as valves, are to be independently supported.

5.8 Valves, accessories and fittings

5.8.1 General

Cocks, valves and other accessories are generally to be arranged so that they are easily visible and accessible for manoeuvring, control and maintenance. They are to be installed in such a way as to operate properly.

5.8.2 Valves and accessories

In machinery spaces and tunnels, the cocks, valves and other accessories of the fluid lines referred to in this Section are to be placed:

- above the floor, or
- when this is not possible, immediately under the floor, provided provision is made for their easy access and control in service.

5.8.3 Flexible hoses and expansion joints

a) Flexible hoses and expansion joints are to be in compliance with [2.6]. They are to be installed in clearly visible and readily accessible locations.

b) The number of flexible hoses and expansion joints is to be kept to the minimum.

c) In general, flexible hoses and expansion joints are to be limited to a length necessary to provide for relative movement between fixed and flexibly mounted items of machinery/equipment or systems.

d) The installation of a flexible hose assembly or an expansion joint is to be in accordance with the manufacturer's instructions and use limitations, with particular attention to the:
   - orientation
   - end connection support (where necessary)
   - avoidance of hose contact that could cause rubbing and abrasion
   - minimum bend radii.

e) Flexible hose assemblies or expansion joints are not to be installed where they may be subjected to torsion deformation (twisting) under normal operating conditions.

f) Where flexible hoses or expansion joints are intended to be used in piping systems conveying flammable fluids that are in close proximity of heated surfaces, the risk of ignition due to failure of the hose assembly and subsequent release of fluids is to be mitigated, as far as practicable, by the use of screens or other similar protection, to the satisfaction of the Society.

g) The adjoining pipes are to be suitably aligned, supported, guided and anchored.

h) Isolating valves are to be provided, permitting the isolation of flexible hoses intended to convey flammable oil or compressed air.

i) Expansion joints are to be protected against over extension or over compression.

j) Where they are likely to suffer external damage, flexible hoses and expansion joints of the bellows type are to be provided with adequate protection.

5.8.4 Thermometers

Thermometers and other temperature-detecting elements in fluid systems under pressure are to be provided with pockets built and secured so that the thermometers and detecting elements can be removed while keeping the piping under pressure.

5.8.5 Pressure gauges

Pressure gauges and other similar instruments are to be fitted with an isolating valve or cock at the connection with the main pipe.

5.8.6 Nameplates

a) Accessories such as cocks and valves on the fluid lines referred to in this Section are to be provided with nameplates indicating the apparatus and lines they serve except where, due to their location on board, there is no doubt as to their purpose.

b) Nameplates are to be fitted at the upper part of air and sounding pipes.

5.9 Additional arrangements for flammable fluids

5.9.1 General

All necessary precautions are to be taken to reduce fire risks from flammable liquids, such as:

- drips
- leaks under pressure
- overflow
- hydrocarbon accumulation in particular under lower floors
- discharges of oil vapours during heating
- soot or unburnt residue in smoke stacks or exhaust pipes.

Unless otherwise specified, the requirements in [5.9.2] apply to:

- fuel oil systems, in all spaces
- lubricating oil systems, in machinery spaces
- other flammable oil systems, in locations where means of ignition are present.

5.9.2 Prevention of flammable oil leakage ignition

a) As far as practicable, the piping arrangement in the flammable oil systems is to comply generally with the following:

   - The conveying of flammable oils through accommodation and service spaces is to be avoided. Where it is not possible, the arrangement may be subject to special consideration by the Society, provided that the pipes are of a material approved with regard to the fire risk.
   - The pipes are not to be located immediately above, or close to, the hot surfaces (exhaust manifolds, silencers, steam pipelines, boilers, etc.), electrical installations or other sources of ignition. Otherwise, suitably protection (screening and effective drainage to a safe position) is to be provided to prevent spraying or leakage onto the sources of ignition.
   - Parts of the piping systems conveying heated flammable oils under pressure exceeding 1,8 bar are to be placed above the platform or in any other position where defects and leakage can readily be observed. The machinery spaces in way of such parts are to be adequately illuminated.

b) No flammable oil tanks are to be situated where spillage or leakage therefrom can constitute a hazard when falling on:

   - hot surfaces, including those of boilers, heaters, steam pipes, exhaust manifolds and silencers
   - electrical equipment
   - air intakes
   - other sources of ignition.

c) Parts of flammable oil systems under pressure exceeding 1,8 bar such as pumps, filters and heaters are to comply with the provisions of item b) above.

d) Pipe connections, expansion joints and flexible parts of flammable oil lines are to be screened or otherwise suitably protected to avoid, as far as practicable, oil spray or oil leakages onto hot surfaces, into machinery air intakes, or on other sources of ignition.

e) Any relief valve or air vent cock fitted within the flammable liquid systems is to discharge to a safe position, such as an appropriate tank.

f) Appropriate means are to be provided to prevent undue opening (due to vibrations) of air venting cocks fitted on equipment or piping containing flammable liquid under pressure.

5.9.3 Provisions for flammable oil leakage containment

a) Tanks used for the storage of flammable oils together with their fittings are to be so arranged as to prevent spillages due to leakage or overfilling.

b) Drip trays with adequate drainage to contain possible leakage from flammable fluid systems are to be fitted:

- under independent tanks
- under burners
- under purifiers and any other oil processing equipment
- under pumps, heat exchangers and filters
- under valves and all accessories subject to oil leakage
- surrounding internal combustion engines.

c) The coaming height of drip trays is to be appropriate for the service and not less than 75 mm.

d) Where drain pipes are provided for collecting leakages, they are to be led to an appropriate drain tank.

e) The draining system of the room where thermal fluid heaters are fitted, as well as the save all of the latter, are not to allow any fire extension outside this room.

5.9.4 Drain tank

a) The drain tank is not to form part of an overflow system and is to be fitted with an overflow alarm device.

b) In units required to be fitted with a double bottom, appropriate precautions are to be taken, when the drain tank is constructed in the double bottom, in order to avoid flooding of the machinery space where drip trays are located, in the event of accidentally running aground.

5.9.5 Valves

All valves and cocks forming part of flammable oil systems are to be capable of being operated from readily accessible positions and, in machinery spaces, from above the working platform.

5.9.6 Level switches

Level switches fitted to flammable oil tanks are to be contained in a steel or other fire-resisting enclosure.

6 Certification, inspection and testing of piping systems

6.1 General

6.1.1 The certification and workshop inspection and testing programme to be performed on:

- the various components of piping systems
- the materials used for their manufacture

are to comply with the applicable requirements of NR217, Pt C, Ch 1, Sec 20.

SECTION 4 PIPING SYSTEMS

1 General

1.1 Scope and application

1.1.1 This Section contains specific requirements applying to piping systems, including valves, fittings and pumps, which are necessary for the operation of the on-board machinery and equipment. They also apply to piping systems used in the operation of the unit whose failure could directly or indirectly impair the safety of the unit or persons, and to piping systems which are dealt with in other Sections of the Rules.

1.1.2 Piping systems not covered by this Section are to comply with the applicable requirements of NR217, Pt C, Ch 1, Sec 10.

2 Bilge systems

2.1 Application

2.1.1 This Article applies to bilge systems of floating establishments.

2.2 Principle

2.2.1 General

An efficient bilge pumping system is to be provided, capable of pumping from and draining any watertight compartment other than a space permanently appropriated for the storage of fresh water, water ballast or fuel oil and for which other efficient means of pumping are to be provided, under all practical conditions.

Bilge pumping system is not intended at coping with water ingress resulting from structural or main river water piping damage.

2.2.2 Availability of the bilge system

The bilge system is to be able to work while the other essential installations of the unit, especially the fire-fighting installations, are in service.

2.2.3 Bilge and ballast systems

The arrangement of the bilge and ballast pumping system is to be such as to prevent the possibility of water passing from the river and from water ballast spaces to the machinery spaces, or from one compartment to another.

2.3 Design of bilge systems

2.3.1 General

a) The bilge pumping system is to consist of pumps connected to a bilge main line so arranged as to allow the draining of all spaces mentioned in [2.2.1] through bilge branches, distribution boxes and bilge suctions, except for some small spaces where individual suctions by means of hand pumps may be accepted.

b) If deemed acceptable by the Society, bilge pumping arrangements may be dispensed with in specific compartments, provided the safety of the unit is not impaired.

2.3.2 Number and distribution of bilge suctions

a) Draining of watertight spaces is to be possible, when the unit is on an even keel and either is upright or has a list of up to 5°, by means of, at least:
   - two suctions in machinery spaces below bulkhead deck
   - one suction in the other spaces.

b) Bilge suctions are to be arranged as follows:
   - wing suctions are generally to be provided, except in the case of short and narrow compartments when a single suction ensures effective draining in the above conditions
   - in the case of compartments of unusual form, additional suctions may be required to ensure effective draining under the conditions mentioned in item a).

c) In all cases, arrangements are to be made such as to allow a free and easy flow of water to bilge suctions.

2.3.3 Prevention of communication between spaces - Independence of the lines

a) Bilge lines are to be so arranged as to avoid inadvertent flooding of any dry compartment.

b) Bilge lines are to be entirely independent and distinct from the other lines except where permitted in Ch 1, Sec 3, [5.4].

2.4 Draining of machinery spaces

2.4.1 Branch bilge suction

The branch bilge suction is to be connected to the bilge main.

2.4.2 Monitoring

For monitoring of level of machinery space bilges, see Ch 2, Sec 12.

2.5 Draining of other dry spaces

2.5.1 General

a) Except where otherwise specified, bilge suctions are to be branch bilge suctions, i.e. suctions connected to a bilge main.

b) Draining arrangements of tanks are to comply with the provisions of [2.2.3].

2.5.2 Peaks

Where the peak tanks are not connected to the ballast system, separate means of pumping are to be provided. Where the peak terminates at the engine room, it may be drained to the engine room bilge through a pipe fitted with a shutoff valve.

2.5.3 Cofferdams and void spaces

Bilge pumping arrangements are to be provided for cofferdams and void spaces.

2.6 Bilge pumps

2.6.1 Number of bilge pumps

Units with installed power of up to 225 kW are to have one bilge pump. Where the installed power is greater than 225 kW, a second bilge pump is to be provided.

2.6.2 Use of ejectors

One of the pumps may be replaced by a hydraulic ejector connected to a high pressure water pump and capable of ensuring the drainage under similar conditions to those obtained with the other pump.

The pump supplying the ejector is not to be used for other services.

2.6.3 Use of other pumps for bilge duties

a) Other pumps may be used for bilge duties, such as fire, general service, sanitary service or ballast pumps, provided that:
   - they meet the capacity requirements
   - suitable piping arrangements are made
   - pumps are available for bilge duty when necessary.

b) The use of bilge pumps for fire duty is to comply with the provisions of Part C, Chapter 3.

2.6.4 Capacity of independent pumps

a) The minimum capacity of the main pump, Q_1, in m^3/h, is not to be less than:

   $Q_1 = 6 \cdot 10^{-3}\, d_1^2$

   where:

   d_1 : Inside diameter of the main bilge pipe, in mm, as defined in [2.7.1].

b) The minimum capacity of the second pump, Q_2, in m^3/h, is not to be less than:

   $Q_2 = 6 \cdot 10^{-3}\, d_2^2$

   where:

   d_2 : Inside diameter of the branch bilge pipe, in mm, as defined in [2.7.1].

2.6.5 Choice of the pumps

a) Bilge pumps are to be of the self-priming type. Centrifugal pumps are to be fitted with efficient priming means, unless an approved priming system is provided to ensure the priming of pumps under normal operating conditions.

b) Ballast and general service pumps may be accepted as independent power bilge pumps, if fitted with the necessary connections to the bilge pumping system.

c) For compartments of small sizes, hand pumps operable from a position located above the load waterline are acceptable.

2.6.6 Connection of power pumps

a) Bilge pumps and other power pumps serving essential services which have common suction or discharge are to be connected to the pipes in such a way that:
   - compartments and piping lines remain segregated in order to prevent possible intercommunication
   - the operation of any pump is not affected by the simultaneous operation of other pumps.

b) The isolation of any bilge pump for examination, repair or maintenance is to be made possible without impeding the operation of the remaining bilge pumps.

2.7 Size of bilge pipes

2.7.1 The inside diameter of bilge pipes, in mm, is to be less than neither 35 mm nor the values derived from the following formulae:

- Inside diameter of main bilge pipes:

$$d_1 = 1,5\sqrt{(B+D)L} + 25$$

- Inside diameter of branch bilge pipes:

$$d_2 = 2,0\sqrt{(B+D)\ell} + 25$$

where:

L : Rule length, in m, defined in Pt B, Ch 1, Sec 2, [1.1]

B : Breadth, in m, defined in Pt B, Ch 1, Sec 2, [1.2]

D : Depth, in m, defined in Pt B, Ch 1, Sec 2, [1.3]

ℓ : Length of the watertight compartment, in m.

d_2 may be taken not greater than d_1.

2.8 Bilge accessories

2.8.1 Screw-down non-return valves

a) Accessories are to be provided, to prevent intercommunication of compartments or lines which are to remain segregated from one another:
   - on the pipe connections to bilge distribution boxes
   - on the suctions of pumps which have also connections from the river or from compartments normally intended to contain liquid
   - on flexible bilge hose connections
   - at the open end of bilge pipes passing through deep tanks
   - in the discharge pipe of the pump, where the direct suction is connected to a centrifugal pump which can also be used for cooling water, ballast water or fire extinguishing.

b) Screw-down and other non-return valves are to be of a recognised type which does not offer undue obstruction to the flow of water.

2.8.2 Mud boxes

In machinery spaces, termination pipes of bilge suctions are to be straight and vertical and are to be led to mud boxes so arranged as to be easily inspected and cleaned.

The lower end of the termination pipe is not to be fitted with a strum box.

2.8.3 Strum boxes

a) In compartments other than machinery spaces, the open ends of bilge suction pipes are to be fitted with strum boxes or strainers having holes not more than 10 mm in diameter. The total area of such holes is to be not less than twice the required cross-sectional area of the suction pipe.

b) Strum boxes are to be so designed that they can be cleaned without having to remove any joint of the suction pipe.

2.9 Bilge piping arrangement

2.9.1 Passage through double bottom compartments

Bilge pipes are not to pass through double bottom compartments. If such arrangement is unavoidable, the parts of bilge pipes passing through double bottom compartments are to have reinforced thickness as per Ch 1, Sec 3, Tab 14 for steel pipes.

2.9.2 Passage through deep tanks

The parts of bilge pipes passing through deep tanks intended to contain water ballast, fresh water or fuel oil are normally to be contained within pipe tunnels. Alternatively, such parts are to have reinforced thickness, as per Ch 1, Sec 3, Tab 14 for steel pipes, and are to be made of either one piece or several pieces assembled by welding, by reinforced flanges or by devices deemed equivalent for the application considered; the number of joints is to be as small as possible. These pipes are to be provided, at their ends in the holds, with non-return valves.

2.9.3 Provision for expansion

Where necessary, bilge pipes inside tanks are to be fitted with expansion bends. Sliding joints are not permitted for this purpose.

2.9.4 Connections

Connections used for bilge pipes passing through tanks are to be welded joints or reinforced flange connections.

2.9.5 Access to valves and distribution boxes

All distribution boxes and manually operated valves in connection with the bilge pumping arrangement are to be in positions which are accessible under ordinary circumstances.

3 Drinking water, scuppers and sanitary discharges

3.1 Drinking water systems

3.1.1 Drinking water tanks

a) Scantlings of drinking water tanks forming part of the unit’s structure are to comply with Part B, Chapter 5.

   Scantlings of independent drinking water tanks are to comply with Ch 1, Sec 3, [2.12].

b) Drinking water tanks are not to share walls with other tanks.

c) Pipes which do not carry drinking water are not to be routed through drinking water tanks.

d) Air and overflow pipes of drinking water tanks are to comply with [4]. They may not be connected to other pipes and may not be routed through tanks which do not contain drinking water. the upper openings of air and overflow pipes are to be protected against the entry of insects.

e) Sounding pipes are to terminate at a sufficient height above the deck and may not be laid through tanks which contain other media than water.

3.1.2 Drinking water piping

a) Drinking water piping may not be connected to piping systems carrying other media and may not be laid through tanks not containing drinking water.

b) The supply of drinking water into tanks other than drinking water tanks, e.g. expansion tanks of engine fresh water cooling systems, is to take place through open funnels or devices to prevent flow-back.

c) The filling connections of drinking water tanks are to be placed at a sufficient height above the deck, and capable of being closed.

3.1.3 Drinking water pumps

Separate drinking water pumps are to be provided for drinking water systems.

3.2 Scuppers and sanitary discharges

3.2.1 Application

a) This sub-article applies to:
   - scuppers and sanitary discharge systems, and
   - discharges from sewage tanks.

b) Discharges in connection with machinery operation are dealt with in Ch 1, Sec 3, [2.8].

3.2.2 For scuppers and overboard discharges materials and scantlings, see Pt B, Ch 6, Sec 3, [5].

3.2.3 Sewage and grey water discharges

The requirements specified below are general and should apply to any unit fitted with sewage and grey water piping systems.

a) Except otherwise specified, the sewage (or black water) means:
   - drainage and other wastes from any form of toilets and urinals
   - drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises
   - drainage from spaces containing living animals; or
   - other waste waters when mixed with the drainages defined above.

b) Grey water means other sanitary discharges which are not sewage.

c) In general, sewage systems should be of a design which avoids the possible generation of toxic and flammable gases (such as hydrogen sulfide, methane, ammonia) during the sewage collection and treatment. Additional means of protection is to be suitable ventilation of the paprika and tanks.

d) Drain lines from the hospital area should be, as far as practicable, separated from other discharges and fitted to the drain collector at the lowest level.

e) Sewage and grey water may be collected into storage tanks together or separately, either for holding prior to transfer to a treatment unit, or for later discharge. Any tank used for holding sewage is to comply with the following:
   - suitable air pipes are to be fitted, leading to the open deck
   - design and configuration of those tanks should be such as to facilitate the effective drainage and flushing of the tanks
   - suitable means for flushing of the tanks are to be provided
   - such tanks are to be efficiently protected against corrosion
   - tanks are to have a means to indicate visually the amount of its content
   - suitable means for emptying sewage tanks through the standard discharge connection to reception facilities are to be provided. Ballast and bilge pumps are not to be used for that purpose.

f) Air pipes from the sewage and grey water systems are to be independent of all other air pipes and to be led to the outside of the unit, away from any air intake. Such pipes should not terminate in areas to which personnel have frequent access and should be clear of any sources of ignition.

g) The overboard discharges are to be located as far from river water inlets as possible. In general, the sewage outlets should be located below load line.

h) The sewage and grey water discharge lines are to be fitted at the units' side with screw-down valve and non-return valve.

The non-return valve may be omitted where the open inlets of the sanitary discharge are situated sufficiently high above the bulkhead deck and the pipe wall thicknesses are equal to that of the unit’s shell.

4 Air, sounding and overflow pipes

4.1 Air pipes

4.1.1 Principle

Air pipes are to be fitted to all tanks, double bottoms, cofferdams, tunnels and other compartments which are not fitted with alternative ventilation arrangements, in order to allow the passage of air or liquid so as to prevent excessive pressure or vacuum in the tanks or compartments, in particular in those which are fitted with piping installations.

4.1.2 Number and position of air pipes

a) Air pipes are to be so arranged and the upper part of compartments so designed that air or gas likely to accumulate at any point in the compartments can freely evacuate.

b) Air pipes are to be fitted opposite the filling pipes and/or at the highest parts of the compartments, the unit being assumed to be on an even keel.

c) In general, two air pipes are to be fitted for each compartment, except in small compartments, where only one air pipe may be accepted. When the top of the compartment is of irregular form, the position of air pipes is to be given special consideration by the Society.

Note 1: Two air vents are normally required for long tanks e.g. a ballast tank in a double hull unit.

In machinery spaces, two air vents are not normally required.

d) Where only one air pipe is provided, it is not to be used as a filling pipe.

4.1.3 Height of air pipes

Their open ends are to be so arranged as to prevent the free entry of water in the compartment.

The height d_{AP}, in m, of air pipes above the deck is to be such that:

$$z_{AP} \geq MAX\,(T + 0{,}3\ ;\ z_{LE}) + \delta_{AP}$$

where:

z_{AP} : Z co-ordinate, in m, of the top of air pipe

z_{LE} : Z co-ordinate, in m, of the lower end (above deck) of air pipe

T : Draught, in m

δ_{AP} : Increase of air pipe height, in m
   - for pipes with closing devices:
     $\delta_{AP} = 0{,}15$
   - for pipes without closing devices:
     $\delta_{AP} = 0{,}20$

4.1.4 Construction of air pipes

Where tanks are filled by pumping through permanently installed pipelines, the inside cross-section of the air pipes is to equal at least 125% that of the corresponding filling pipe.

4.1.5 Special arrangements for air pipes of flammable oil tanks

Air pipes of lubricating oil storage tanks may terminate in the engine room. Air pipes of the lubricating oil storage tanks which forming part of the unit's shell are to terminate in the engine room casing above the bulkhead deck.

It is necessary to ensure that no leaking oil can spread on to heated surfaces where it may ignite.

The air pipes of lubricating oil tanks, gear and engine crankshaft casings are not to be led to a common line.

4.1.6 Other arrangements for air pipes

Air pipes are to be laid vertically. Air pipes passing through cargo holds are to be protected against damage.

Cofferdams and void spaces with bilge connections are to be provided with air pipes terminating above the open deck.

4.2 Sounding pipes

4.2.1 Principle

a) Sounding devices are to be fitted to tanks intended to contain liquids as well as to all compartments which are not readily accessible at all times (void spaces, cofferdams and bilges (bilge wells)).

b) For compartments normally intended to contain liquids, the following systems may be accepted in lieu of sounding pipes:
   - a level gauge of an approved type efficiently protected against shocks, or
   - a remote level gauging system of an approved type, provided an emergency means of sounding is available in the event of failure affecting such system.

c) The internal diameter of sounding pipes is not to be less than 32 mm. Where sounding pipes pass through refrigerated spaces, or through the insulation of refrigerated spaces in which the temperature may be below 0°C, their internal diameter is to be at least 60 mm.

4.2.2 General arrangement

As far as possible, sounding pipes are to be laid straight and are to extend as near as possible to the bottom of the tank.

Sounding pipes which terminate below the deepest load waterline are to be fitted with self-closing shutoff devices. Such sounding pipes are only permissible in spaces which are accessible at all times. All other sounding pipes are to be extended to the open deck. The sounding pipe openings are always to be accessible and fitted with watertight closures.

Sounding pipes of tanks are to be provided close to the top of the tank with holes for equalizing the pressure.

A striking pad is to be fitted under every sounding pipe. Where sounding pipes are connected to the tanks over a lateral branch pipe, the branch-off under the sounding pipe is to be adequately reinforced.

4.2.3 Sounding pipes for fuel and lubricating oil tanks

Where sounding pipes cannot be extended above the open deck, they are to be provided with self-closing shutoff devices as well as with self-closing test valves.

The openings of sounding pipes are to be located at a sufficient distance from boilers, electrical equipment and hot components.

Sounding pipes are not to terminate in accommodation or service spaces. They are not to be used as filling pipes.

4.3 Overflow pipes

4.3.1 Principle

Overflow pipes are to be fitted to tanks:

- which can be filled by pumping and are designed for a hydrostatic pressure lower than that corresponding to the height of the air pipe, or
- where the cross-sectional area of air pipes is less than that prescribed in [4.1.4].

4.3.2 Design of overflow systems

a) Overflow pipes are to be led:
   - either outside, or
   - in the case of fuel oil or lubricating oil, to an overflow tank of adequate capacity or to a storage tank having a space reserved for overflow purposes.

b) Overflows from service tanks are generally to be led back either to the fuel bunkers, or to an overflow tank of appropriate capacity.

c) Where tanks containing the same or different liquids are connected to a common overflow system, the arrangement is to be such as to prevent any risk of:
   - intercommunication between the various tanks due to movements of liquid when emptying or filling, or due to the inclination of the unit
   - overfilling of any tank from another assumed flooded due to hull damage.

   For this purpose, overflow pipes are to be led to a high enough point above the deepest load waterline or, alternatively, non-return valves are to fitted where necessary.

d) Arrangements are to be made so that a compartment cannot be flooded from the river water through the overflow in the event of another compartment connected to the same overflow main being bilged. To this end, the openings of overflow pipes discharging overboard are as a rule to be placed above the deepest load waterline and are to be fitted where necessary with non-return valves on the plating, or, alternatively, overflow pipes from tanks are to be led to a point above the deepest load waterline.

e) Where tanks alternately containing fuel oil and ballast water are connected to a common overflow system, arrangements are to be made to prevent the ballast water overflowing into the tanks containing fuel oil and vice-versa.

4.3.3 Overflow tanks

a) Overflow tanks are to be fitted with an air pipe complying with [4.1.1] which may serve as an overflow pipe for the same tank. When the vent pipe reaches a height exceeding the design head of the overflow tank, suitable means are to be provided to limit the actual hydrostatic head on the tank.

Such means are to discharge to a position which is safe in the opinion of the Society.

b) An alarm device is to be provided to give warning when the oil reaches a predetermined level in the tank, or alternatively, a sight-flow glass is to be provided in the overflow pipe to indicate when any tank is overflowing. Such sight-flow glasses are only to be placed on vertical pipes and in readily visible positions.

4.3.4 Specific arrangements for construction of overflow pipes

a) The internal diameter of overflow pipes is not to be less than 50 mm.

b) In each compartment which can be pumped up, the total cross-sectional area of overflow pipes is not to be less than 1,25 times the cross-sectional area of the corresponding filling pipes.

c) The cross-sectional area of the overflow main is not to be less than the aggregate cross-sectional area of the two largest pipes discharging into the main.

d) Where overflow sight glasses are provided, they are to be in a vertically dropping line on readily visible position, fitted with adequate protection from mechanical damage and well lit.

The overflow sight glasses are not to be used in fuel oil systems.

Use of the overflow sight glasses in lubricating oil systems may be accepted provided that:

- they are so designed that oil does not impinge on the glass
- the glass is to be of heat resisting quality.

5 Water cooling systems

5.1 Application

5.1.1 This Article applies to cooling systems using the following cooling media:

- river water
- fresh water.

Lubricating oil and air cooling systems are to be given special consideration.

5.2 Principle

5.2.1 General

River water and fresh water cooling systems are to be so arranged as to maintain the temperature of the cooled media (lubricating oil, hydraulic oil, charge air, etc.) within the manufacturers' recommended limits during all operations, including starting and manoeuvring, under the inclination angles and the ambient conditions specified in Ch 1, Sec 1.

5.3 Design of river water cooling systems

5.3.1 General

River water cooling of the engines and other essential equipment is to be capable of being supplied by two different means.

5.3.2 River chest

Each river chest is to be provided with an air pipe which can be shutoff and which is to extend above the bulkhead deck. The inside diameter of the air pipe is to be compatible with the size of the river chests and is not to be less than 30 mm.

Where compressed air is used to blow through river chests, the pressure is not to exceed 2 bar.

5.3.3 Intake valves

The cooling water pumps of important auxiliaries should be connected to the river chests over separate valves.

5.3.4 Filters

The suction lines of cooling water pumps for important auxiliaries are to be fitted with filters which can be cleaned in service.

5.4 Design of fresh water cooling systems

5.4.1 Expansion tanks

The fresh water cooling system is to be provided with expansion tanks located at a sufficient height. The tanks are to be fitted with a filling connection, a water level indicator and an air pipe. A venting is to connect the highest point of the cooling water common pipe to the expansion tank.

In closed circuits, the expansion tanks are to be fitted with overpressure/underpressure valves.

5.4.2 Water coolers

For fresh water coolers forming part of the unit shell plating and for special outboard coolers, provision is to be made for satisfactory deaeration of the cooling water.

5.5 Control and monitoring

5.5.1 For control and monitoring of water cooling systems of diesel engines, see Part C, Chapter 2.

6 Fuel oil systems

6.1 Application

6.1.1 Scope

This Article applies to all fuel oil systems supplying any kind of installation.

The fuel oils used on board are to comply with Ch 1, Sec 1, [2.6].

6.1.2 For fuel oil supply equipment forming part of diesel engines, see Ch 1, Sec 2.

6.2 Fuel oil tanks and bunkers

6.2.1 Liquid fuel oil is to be stored in oiltight tanks which either may form part of the hull or is to be solidly connected with the unit hull.

6.2.2 Fuel oil bunkers and tanks provided in the machinery space are not to be located above the boilers nor in places where they are likely to reach a high temperature, unless special arrangements are provided with the agreement of the Society.

6.2.3 Gutterways are to be fitted at the foot of bunker bulkheads in the machinery space in order to facilitate the flow of liquid due to eventual leaks towards the bilge suctions.

The gutterways may however be dispensed with if the bulkheads are entirely welded.

6.2.4 Where ceilings are fitted on the tank top or on the top of deep tanks intended for the carriage of fuel oil, they are to rest on grounds 30 mm in depth so arranged as to facilitate the flow of liquid due to eventual leaks towards the bilge suctions.

The ceilings may be positioned directly on the plating in the case of welded top platings.

6.2.5 Tanks and fuel pipes are to be so located and equipped that fuel cannot spread either inside the unit or on deck and cannot be ignited by hot surfaces or electrical equipment. Tanks are to be fitted with air and overflow pipes to prevent excessive pressure (see [4]).

If tanks are interconnected, the cross-section of the connecting pipe is to be at least 1,25 times the cross-section of the filler neck.

6.2.6 Fuel supply

The fuel supply is to be stored in several tanks so that, even in event of damage to one tank, the fuel supply is not entirely lost (at least 1 storage tank and 1 service/settling tank).

6.2.7 Location

The location of fuel oil tanks is to be in compliance with Pt B, Ch 2, Sec 1, [2.1], particularly as regards the installation of cofferdams, the separation between fuel oil tanks or bunkers and other spaces of the unit.

6.2.8 Scantlings

Scantlings of fuel oil tanks forming part of the unit's structure are to comply with Part B, Chapter 1.

Scantlings of independent fuel oil tanks are to comply with Ch 1, Sec 3, [2.12].

6.3 Fuel tank fittings and mountings

6.3.1 For fuel filling and suction systems see [6.5]; for air, overflow and sounding pipes, see [4].

The open ends of air pipes and overflow pipes leading to the deck are to be provided with a protecting screen.

6.3.2 Free discharge and drainage lines are to be fitted with self-closing shutoff valves.

6.3.3 Tank gauges

The following tank gauges are permitted:

- Sounding pipes
- Oil level indicating devices
- Oil gauges with flat glasses and self-closing shutoff valves at the connections to the tank and protected against external damage.

For fuel storage tanks, the provision of sounding pipes is sufficient. Such sounding pipes need not be fitted to tanks equipped with oil level indicating devices which have been type-tested by the Society.

Fuel service tank supplying important auxiliaries are to be fitted with visual and audible low level alarm which has been approved by the Society.

Sight glasses and oil gauges fitted directly on the side of the tank and round glass oil gauges are not permitted.

Sounding pipes of fuel tanks may terminate neither in accommodation nor in spaces where the risk of ignition of spillage from the sounding pipes might arise.

6.4 Attachment of mountings and fittings to fuel tanks

6.4.1 Only appliances, mountings and fittings forming part of the fuel tank equipment may generally be fitted to tank surfaces.

6.4.2 Valves and pipe connections are to be attached to strengthening flanges welded to the tank surfaces. Holes for attachment bolts are not to be drilled in the tank surfaces. Instead of strengthening flanges, short, thick pipe flange connections may be welded into the tank surfaces.

6.5 Filling and delivery system

6.5.1 The filling of fuels is to be effected from the open deck through permanently installed lines.

6.6 Tank filling and suction systems

6.6.1 Fuel pumps are to be equipped with emergency stops.

6.6.2 Filling and suction lines are to be fitted with remote controlled shutoff valves.

6.6.3 The emergency stops and the remote-controlled shutoff valves are to be capable of being operated from a permanently accessible open deck and protected from unauthorized use.

6.6.4 Air and sounding pipes are not to be used to fill fuel tanks.

6.6.5 The inlet openings of suction pipes are to be located above the drain pipes.

6.6.6 Service tanks of up to 50 liters capacity mounted directly on diesel engines need not be fitted with remote controlled shutoff valves.

6.7 Pipe layout

6.7.1 Fuel lines may not pass through tanks containing feedwater, drinking water or lubricating oil.

6.7.2 Fuel lines may not be laid in the vicinity of hot engine components, boilers or electrical equipment. The number of detachable pipe connections is to be limited. Shutoff valves in fuel lines are to be operable from above the floor plates in machinery spaces.

Glass and plastic components are not permitted in fuel systems.

6.7.3 Shutoff valves in fuel return (spill) lines to tanks may be permitted, ensuring that return line to the tanks under normal operating conditions cannot be blocked.

6.8 Control and monitoring

6.8.1 See Part C, Chapter 2.

7 Lubricating oil systems

7.1 Application

7.1.1 Scope

This Article applies to lubricating oil systems serving all kind of installations for lubrication purposes.

7.1.2 For lubricating oil supply equipment forming part of diesel engines, see Ch 1, Sec 2.

7.2 Lubricating oil tank

7.2.1 Lubricating oil is to be carried in oiltight tanks which either may form part of the hull or is to be solidly connected with the unit hull.

7.2.2 Lubricating oil tanks and their fittings are not to be located directly above engines or exhaust pipes.

7.2.3 Lubricating oil tanks and pipes are to be so located and equipped that lubricating oil cannot spread either inside the unit or on deck and cannot be ignited by hot surfaces or electrical equipment. Tanks are to be fitted with air and overflow pipes to prevent excessive pressure (see [4]).

7.2.4 The location of lubricating oil tanks is to be in compliance with Part B, Chapter 1, particularly as regards the installation of cofferdams, the separation between lubricating oil tanks and other spaces of the unit.

7.2.5 Scantlings of lubricating oil tanks forming part of the unit structure are to comply with Part B, Chapter 1.

Scantlings of independent lubricating oil tanks are to comply with Ch 1, Sec 3, [2.12].

7.2.6 Control and monitoring

See Part C, Chapter 2.

7.3 Tank fittings and mountings

7.3.1 Oil level glasses are to be connected to the tanks by means of self-closing shutoff valves.

7.4 Capacity and construction of tanks

7.4.1 Lubricating oil circulating tanks should be sufficiently large to ensure that the dwelling time of the oil is long enough for the expulsion of air bubbles, the settling out of residues etc. The tanks are to be large enough to hold at least the lubricating oil contained in the entire circulation system.

7.4.2 Measures, such as the provision of baffles or limber holes are to be taken to ensure that the entire contents of the tank remain in circulation. Limber holes should be located as near the bottom of the tank as possible. Lubricating oil drain pipes from engines are to be submerged closed to the tank bottom at their outlet ends. Suction pipe connections should be placed as far as is practicable from oil drain pipes so that neither air nor sludge can be sucked up irrespective of the inclination of the unit.

7.4.3 Lubricating oil drain tanks are to be equipped with vent pipes in compliance with [4].

7.5 Lubricating oil piping

7.5.1 Lubricating oil systems are to be constructed to ensure reliable lubrication over the whole range of speed and during run-down of the engines and to ensure adequate heat transfer.

7.5.2 Priming pumps

Where necessary, priming pumps are to be provided for supplying lubricating oil to the engines.

7.6 Lubricating oil pumps

7.6.1 The suction connections of lubricating oil pumps are to be located as far as possible from drain pipes.

8 Hydraulic systems

8.1 General

8.1.1 Scope

The Rules contained in this Article apply to hydraulic power installations used, for example, to operate closing appliances in the unit's shell, landing ramps and hoists. The Rules are to be applied in analogous manner to unit's other hydraulic systems.

8.1.2 Hydraulic oil is to be carried in oiltight tanks which either may form part of the hull or is to be solidly connected with the unit hull.

8.1.3 Hydraulic oil tanks and their fittings are not to be located directly above engines or exhaust pipes.

8.1.4 Hydraulic oil tanks and pipes are to be so located and equipped that hydraulic oil cannot spread either inside the unit or on deck and cannot be ignited by hot surfaces or electrical equipment. Tanks are to be fitted with air and overflow pipes to prevent excessive pressure (see [4]).

8.1.5 The location of thermal oil tanks is to be in compliance with Part B, Chapter 1, particularly as regards the installation of cofferdams, the separation between thermal oil tanks and other spaces of the unit.

No Hydraulic oil tanks may be located beyond the end bulkheads.

8.1.6 Scantlings of hydraulic oil tanks forming part of the unit's structure are to comply with Part B, Chapter 1.

Scantlings of independent hydraulic oil tanks are to comply with Ch 1, Sec 3, [2.12].

8.2 Dimensional design

8.2.1 For the design of pressure vessels, see NR217, Pt C, Ch 1, Sec 3, for the dimensions of pipes, see Ch 1, Sec 3, [2.4].

8.3 Materials

8.3.1 Approved materials

Components fulfilling a major function in the power transmission system are normally to be made of steel or cast steel in accordance with NR216 Materials and Welding. The use of other materials is subject to special agreement with the Society.

Cylinders are preferably to be made of steel, cast steel or nodular cast iron (with a predominantly ferritic matrix).

Pipes are to be made of seamless or longitudinally welded steel tubes.

The pressure-loaded walls of valves, fittings, pumps, motors, etc., are subject to the requirements of Ch 1, Sec 3, [6].

8.3.2 Testing of materials

The materials of pressure casings and pressure oil lines are to possess mechanical characteristics in conformity with NR216 Materials and Welding. Evidence of this may take the form of a certificate issued by the steelmaker which contains details of composition and the results of the tests prescribed in NR216 Materials and Welding.

8.4 Design and equipment

8.4.1 Control

a) Hydraulic systems may be supplied either from a common power station or from a number of power stations, each serving a particular system.

b) Where the supply is from a common power station and in the case of hydraulic drives whose piping system is connected to other hydraulic systems, a second pump set is to be provided.

c) Hydraulic systems are not to be capable of being initiated merely by starting the pump. The movement of the equipment is to be controlled from special operating stations. The controls are to be so arranged that, as soon as they are released, the movement of the hoist ceases immediately.

d) Local controls, inaccessible to unauthorized persons, are to be fitted. The movement of hydraulic equipment should normally be visible from the operating stations. If the movement cannot be observed, audible and/or visual warning devices are to be fitted. In addition, the operating stations are then to be equipped with indicators for monitoring the movement of the hoist.

e) In or immediately at each power unit (ram or similar) used to operate equipment which moves vertically or rotates about a horizontal axis, suitable precautions are to be taken to ensure a slow descent following a pipe rupture.

8.4.2 Pipes

a) The pipes of hydraulic systems are to be installed in such a way as to ensure maximum protection while remaining readily accessible.

b) Pipes are to be installed at a sufficient distance from the unit shell. As far as possible, pipes should not pass through cargo spaces. The piping system is to be fitted with relief valves to limit the pressure to the maximum allowable working pressure.

c) Pipes are to be so installed that they are free from stress and vibration.

d) The piping system is to be fitted with filters for cleaning the hydraulic fluid.

e) Equipment is to be provided to enable the hydraulic system to be vented.

f) The hydraulic fluids are to be suitable for the intended ambient and service temperatures.

g) Where the hydraulic system includes accumulators, the accumulator chamber is to be permanently connected to the safety valve of the associated system. The gas chamber of the accumulators is only to be filled with inert gases. Gas and hydraulic fluid are to be separated by accumulator bags, diaphragms or similar devices.

8.4.3 Oil level indicators

Tanks within the hydraulic system are to be equipped with oil level indicators.

An alarm located in the control station is to fitted for the lowest permissible oil level.

8.4.4 Hose lines

Hose assemblies comprise hoses and their fittings in a fully assembled and tested condition.

High pressure hose assemblies are to be used if necessary for flexible connections. These hose assemblies are to meet the requirements of Ch 1, Sec 3, [2.6] or an equivalent standard. The hose assemblies are to be properly installed and suitable for the relevant operating media, pressures, temperatures and environmental conditions. In systems important to the safety of the unit and in spaces subjected to a fire hazard, the hose assemblies are to be flame-resistant or to be protected correspondingly.

8.5 Testing in manufacturer's works

8.5.1 Testing of power units

The power units of hydraulic systems are required to undergo test on a test stand. The relevant works test certificates are to be presented at time to the final inspection of the hydraulic system.

For electric motors, see Part C, Chapter 2.

Hydraulic pumps are to be subjected to pressure and operational tests in compliance with Ch 1, Sec 3, [6].

Tightness tests are to be performed on components to which this is appropriate.

9 Exhaust gas systems

9.1 General

9.1.1 Application

This Article applies to:

- exhaust gas pipes from engines
- smoke ducts from boilers.

9.1.2 Principle

Exhaust gas systems are to be so designed as to:

- limit the risk of fire
- prevent gases from entering manned spaces
- prevent water from entering engines.

9.2 Design of exhaust systems

9.2.1 Limitation of exhaust line surface temperature

a) Exhaust gas pipes and silencers are to be either water cooled or efficiently insulated where:
   - their surface temperature may exceed 220°C, or
   - they pass through spaces of the unit where a temperature rise may be dangerous.

b) The insulation of exhaust systems is to comply with the provisions of Ch 1, Sec 1, [3.7.1].

9.2.2 Limitation of pressure losses

Exhaust gas systems are to be so designed that pressure losses in the exhaust lines do not exceed the maximum values permitted by the engine or boiler manufacturers.

9.2.3 Intercommunication of engine exhaust gas lines or boiler smoke ducts

a) Exhaust gas from different engines is not to be led to a common exhaust main, exhaust gas boiler or economiser, unless each exhaust pipe is provided with a suitable isolating device.

b) Smoke ducts from boilers discharging to a common funnel are to be separated to a height sufficient to prevent smoke passing from a boiler which is operating to a boiler out of action.

9.2.4 Exhaust gas pipe terminations

a) Where exhaust pipes are led overboard close to the load waterline, means are to be provided to prevent water from entering the engine or the unit.

b) Where exhaust pipes are water cooled, they are to be so arranged as to be self-draining overboard.

9.2.5 Control and monitoring

A high temperature alarm is to be provided in the exhaust gas manifolds of thermal oil heaters to detect any outbreak of fire.

9.3 Arrangement of exhaust piping systems

9.3.1 Provision for thermal expansion

a) Exhaust pipes and smoke ducts are to be so designed that any expansion or contraction does not cause abnormal stresses in the piping system, and in particular in the connection with engine turboblowers.

b) The devices used for supporting the pipes are to allow their expansion or contraction.

9.3.2 Provision for draining

a) Drains are to be provided where necessary in exhaust systems, and in particular in exhaust ducting below exhaust gas boilers, in order to prevent water flowing into the engine.

b) Where exhaust pipes are water cooled, they are to be so arranged as to be self-draining overboard.

9.3.3 Silencers

Engine silencers are to be so arranged as to provide easy access for cleaning and overhaul.

SECTION 5 LIQUEFIED GAS INSTALLATIONS FOR DOMESTIC PURPOSES

1 General

1.1 Application

1.1.1 The requirements of this Section apply to permanently installed domestic liquefied gas installations on board units.

1.1.2 Exceptions to these Rules are possible where they are permitted by the statutory Regulations in force in the area of service.

1.2 General provisions

1.2.1 Liquefied gas installations consist essentially of a supply unit comprising one or more gas receptacles, and of one or more reducing valves, a distribution system and a number of gas-consuming appliances.

1.2.2 Such installations may be operated only with commercial propane.

1.3 Documents for review/approval

1.3.1 Diagrammatic drawings including following information, are to be submitted for review/approval by the Society:

- service pressure
- size and nature of materials for piping
- capacity and other technical characteristics for accessories
- generally, all information allowing the verification of the requirements of the present Section.

2 Gas installations

2.1 General

2.1.1 Liquefied gas installations shall be suitable throughout for use with propane and shall be built and installed in accordance with best practice.

2.1.2 A liquefied gas installation may be used only for domestic purposes in the accommodation spaces.

2.1.3 There may be a number of separate installations on board. A single installation may not be used to serve accommodation areas separated by a hold or a fixed tank.

2.1.4 No part of a liquefied gas installation shall be located in the engine room.

2.2 Gas receptacles

2.2.1 Only receptacles with an approved content of between 5 and 35 kg are permitted.

2.2.2 The gas receptacles must be permanently marked with the test pressure.

2.3 Supply unit

2.3.1 Supply units shall be installed on deck in a freestanding or wall cupboard located outside the accommodation area in a position such that it does not interfere with movement on board. They shall not, however, be installed against the fore or aft bulwark plating. The cupboard may be a wall cupboard set into the superstructure provided that it is gastight and can only be opened from outside the superstructure. It shall be so located that the distribution pipes leading to the gas consumption points are as short as possible.

2.3.2 No more receptacles may be in operation simultaneously than are necessary for the functioning of the installation. Several receptacles may be in operation only if an automatic reversing coupler is used. Up to four receptacles may be in operation per installation. The number of receptacles on board, including spare receptacles, shall not exceed six per installation.

2.3.3 The pressure reducer, or in the case of two-stage reduction the first pressure reducer, shall be fitted to a wall in the same cupboard as the receptacles.

2.3.4 Supply units shall be so installed that any leaking gas can escape from the cupboard into the open without any risk of it penetrating inside the floating unit or coming into contact with a source of ignition.

2.3.5 Cupboards shall be constructed of fire-resistant materials and shall be adequately ventilated by apertures in the top and bottom. Receptacles shall be placed upright in the cupboards in such a way that they cannot be overturned.

2.3.6 Cupboards shall be so built and placed that the temperature of the receptacles cannot exceed 50°C.

2.4 Pressure reducers

2.4.1 Gas-consuming appliances may be connected to receptacles only through a distribution system fitted with one or more reducing valves to bring the gas pressure down to the utilization pressure. The pressure may be reduced in one or two stages. All reducing valves shall be set permanently at a pressure determined in accordance with [2.5].

2.4.2 The final pressure reducers shall be either fitted with or immediately followed by a device to protect the pipe automatically against excess pressure in the event of a malfunctioning of the reducing valve. It shall be ensured that in the event of a breach in the airtight protection device any leaking gas can escape into the open without any risk of it penetrating inside the unit or coming into contact with a source of ignition; if necessary, a special pipe shall be fitted for this purpose.

2.4.3 The protection devices and vents shall be protected against the entry of water.

2.5 Pressure

2.5.1 Where two-stage reducing systems are used, the mean pressure shall be not more than 2,5 bar above atmospheric pressure.

2.5.2 The pressure at the outlet from the last pressure reducer shall be not more than 0,05 bar above atmospheric pressure, with a tolerance of 10%.

2.6 Piping and flexible tubes

2.6.1 Pipes shall consist of fixed steel or copper tubing, in compliance with requirements of Ch 1, Sec 3.

However, pipes connecting with the receptacles shall be high-pressure flexible tubes or spiral tubes suitable for propane. Gas-consuming appliances may be connected by means of suitable flexible tubes not more than 1 m long.

2.6.2 Pipes shall be able to withstand any stresses or corrosive action which may occur under normal operating conditions on board and their characteristics and layout shall be such that they ensure a satisfactory flow of gas at the appropriate pressure to the gas-consuming appliances.

2.6.3 Pipes shall have as few joints as possible. Both pipes and joints shall be gastight and shall remain gastight despite any vibration or expansion to which they may be subjected.

2.6.4 Pipes shall be readily accessible, properly fixed and protected at every point where they might be subject to impact or friction, particularly where they pass through steel bulkheads or metal walls. The entire outer surface of steel pipes shall be treated against corrosion.

2.6.5 Flexible pipes and their joints shall be able to withstand any stresses which may occur under normal operating conditions on board. They shall be unencumbered and fitted in such a way that they cannot be heated excessively and can be inspected over their entire length.

2.7 Distribution system

2.7.1 It shall be possible to shut off the entire distribution system by means of a valve which is at all times easily and rapidly accessible.

2.7.2 Each gas-consuming appliance shall be supplied by a separate branch of the distribution system, and each branch shall be controlled by a separate closing device.

2.7.3 Valves shall be fitted at points where they are protected from the weather and from impact.

2.7.4 An inspection joint shall be fitted after each pressure reducer. It shall be ensured using a closing device that in pressure tests the pressure reducer is not exposed to the test pressure.

2.8 Gas-consuming appliances

2.8.1 The only appliances that may be installed are propane-consuming appliances equipped with devices that effectively prevent the escape of gas in the event of either the flame or the pilot light being extinguished.

2.8.2 Appliances shall be so placed and connected that they cannot overturn or be accidentally moved and as to avoid any risk of accidental wrenching of the connecting pipes.

2.8.3 Heating and water-heating appliances and refrigerators shall be connected to a duct for evacuating combustion gases into the open air.

2.8.4 Gas-consuming appliances may be installed in sleeping quarters only if combustion takes place independently of the air in the quarters.

2.8.5 Gas-consuming appliances in which combustion depends on the air in the rooms in which they are located shall be installed in rooms which are sufficiently large.

3 Ventilation system

3.1 General

3.1.1 In rooms containing gas-consuming appliances in which combustion depends on the ambient air, fresh air shall be supplied and combustion gases evacuated by means of ventilation apertures of adequate dimensions, with a clear section of at least 150 cm^2 per aperture.

3.1.2 Ventilation apertures shall not have any closing device and shall not lead to sleeping quarters.

3.1.3 Evacuation devices shall be so designed as to ensure the safe evacuation of combustion gases. They shall be reliable in operation and made of non-flammable materials. Their operation shall not be affected by the ventilators.

4 Tests and trials

4.1 Definition

4.1.1 A piping shall be considered gastight if, after sufficient time has elapsed for thermal balancing, no drop in the test pressure is noted during the following 10 minutes.

4.2 Testing conditions

4.2.1 The completed installation shall be subjected to tests defined in [4.2.2] to [4.2.8].

4.2.2 Medium-pressure pipes between the closing device, referred to in [2.7.4], of the first reducing device and the valves fitted before the final pressure reducer:

a) pressure test, carried out with air, an inert gas or a liquid at a pressure 20 bar above atmospheric pressure
b) gastightness test, carried out with air or an inert gas at a pressure 3,5 bar above atmospheric pressure.

4.2.3 Pipes at the utilization pressure between the closing device, referred to in [2.7.4], of the single pressure reducer or the final pressure reducer and the valves fitted before the gas-consuming appliances:

- tightness test, carried out with air or an inert gas at a pressure of 1 bar above atmospheric pressure.

4.2.4 Pipes situated between the closing device, referred to in [2.7.4], of the single pressure reducer or the final pressure reducer and the controls of the gas-consuming appliance:

- leak test at a pressure of 0,15 bar above atmospheric pressure.

4.2.5 In the tests referred to in sections [4.2.2](b), [4.2.3] and [4.2.4], the pipes are deemed gastight if, after sufficient time to allow for normal balancing, no fall in the test pressure is observed during the following 10 minutes.

4.2.6 Receptacle connectors, piping and other fittings subjected to the pressure in the receptacles, and joints between the reducing valve and the distribution pipe:

- tightness test, carried out with a foaming substance, at the operating pressure.

4.2.7 All gas-consuming appliances shall be brought into service and tested at the nominal pressure to ensure that combustion is satisfactory with the regulating knobs in the different positions.

Flame failure devices shall be checked to ensure that they operate satisfactorily.

4.2.8 After the test referred to in [4.2.7], it shall be verified, in respect of each gas-consuming appliance connected to a flue, whether, after five minutes operation at the nominal pressure, with windows and doors closed and the ventilation devices in operation, any combustion gases are escaping through the damper.

If there is a more than momentary escape of such gases, the cause shall immediately be detected and remedied. The appliance shall not be approved for use until all defects have been eliminated.

SECTION 6 MISCELLANEOUS EQUIPMENT

1 Pressure equipment

1.1 Principles

1.1.1 Scope of the Rules

The boilers and other pressure vessels, associated piping systems and fittings are to be of a design and construction adequate for the service for which they are intended and are to be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards. The design is to have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

So these Rules apply to “pressure equipment” for the following requirements:

- be safe in sight of pressure risk
- be safe in sight of other risks, moving parts, hot surfaces
- ensure capability of essential services.

“Pressure equipment” means pressure vessels, piping (Ch 1, Sec 4), safety accessories and pressure accessories.

1.1.2 Overpressure risk

Where boilers and other pressure vessels or any parts thereof may be subject to dangerous overpressure, means are to be provided where practicable to protect against such excessive pressure.

1.1.3 Tests

All boilers and other pressure vessels including their associated fittings which are under internal pressure are to be subjected to appropriate tests including a pressure test before being put into service for the first time.

1.2 Design, construction and installation

1.2.1 The design, construction and installation of pressure vessels are to comply with applicable requirements of NR217, Pt C, Ch 1, Sec 3.

1.3 Oil firing equipment

1.3.1 The oil firing equipment of automatically and semi-automatically controlled boilers and thermal oil heaters is subject to the rule requirements in NR217, Pt C, Ch 1, Sec 4, [2].

The oil burners of hot water generators, oil-fired heaters and small heating appliances which are located in the engine room or in spaces containing equipment important to the operation of the machinery are subject to the rule requirements specified under NR217, Pt C, Ch 1, Sec 4, [3].

2 Lifts

2.1 General

2.1.1 Application

The examination of arrangements adopted both for the construction and installation of person and goods lifts on board classed floating establishments as well as the inspections to be carried out by the Surveyors, do not fall within the scope of the classification.

At the request of the Owner, the Building Yard or other Interested Party, the Society may proceed with the certification and inspection in compliance with the Society’s Rules or applicable statutory Regulations.

2.1.2 This Article contains general principles given for guidance only.

2.2 General requirements

2.2.1 The compliance with the provisions laid down in the national and international regulations applicable to land installations apply to the different parts of person and goods lifts such as:

- the lift enclosure and the goods lift well side of the lift well, the protection, in the event of a drop of suspended gear, service panels, etc.
- the design of landing doors
- the dimensions of the lift car, its clearances compared to the lift well and counterweight, protections of the sill, enclosure and lighting, ventilation, car frame, safety gear, counterweight, method of suspension, buffers, etc.
- the lift machinery
- the control and safety circuits.

2.3 Special conditions encountered on board units

2.3.1 The person and goods lifts should be able of running smoothly under environmental and feeding conditions defined hereafter and encountered simultaneously or not.

2.3.2 The machinery may be subject to vibrations transmitted by the unit’s structure and applied to the guides or machinery.

2.3.3 Apparatus are to be able to be maintained in service taking into account the unit motions within specified inclination limits defined in Ch 1, Sec 1, [2.4].

2.3.4 The lift may be subject to normal structural warping effects.

2.3.5 Lifts are to be operable under ambient temperature ranges defined in Ch 1, Sec 1, [2.5].

2.3.6 Lifts are to be satisfactorily protected against the particular risks of corrosion which may be encountered due to their location on board and, in particular, that of their machinery.

2.3.7 The lift is to be able of running, in the case of voltage and frequency variations, under the limits defined in Ch 2, Sec 1, [4.2], in relation to the rated voltage and the assigned frequency.

2.4 Construction and installations

2.4.1 Lift well and lift enclosure

The lift well in which the lift car and the counterweight shift about, should be entirely shut on all its height by means of continuous lift enclosures.

When several apparatus are fitted in the same lift well, they must be separated by a sheet steel over the full lift well height.

No piping and cable runs should be fitted inside the lift well. Nevertheless, it is permitted to fit cable runs in the lift well specifically intended for the feeding, control and safety circuits of the lift, provided that such cable runs meet the applicable rule provisions.

2.4.2 Landing doors

One-leaf swing doors or center opening doors are to be preferably used.

The landing doors are to have the following minimum dimensions:

- height above deck: 2,00 m
- width: 0,80 m.

When telescopic sliding doors are fitted, precautions are necessary in order to take into account the unit's motions.

In addition, landing doors should be fitted with mechanical device, so as to prevent any untimely opening, due to the motion effects of the unit when the lift car is on level with an emergency unlocking device.

The landing doors must not have direct access to machinery rooms or to dangerous areas for which special arrangements are to be applied.

2.4.3 Guiding of the lift car and the counterweight

The lift car and the counterweight should be guided by means of rigid guides (streamlined rod) fixed in succession from one spot to another on the lift enclosure. A special consideration is to be given to the arrangements adopted to prevent the unit structure work from impeding the smooth running of the lift car within the limits of the safety devices.

2.4.4 Travelling cables

Due to the unit's motion, it is necessary to take special arrangements to ensure that under no circumstances, the travelling cables linked to the car be hooked, gripped or damaged.

2.4.5 Emergency means

a) Public lifts

For public lifts, it is considered that the persons in the lift car will be aided from the outside. For this purpose, a sliding ladder is to be provided generally situated in a watch-keeping room or in the machinery room, the use of which gives free access to the lift car roof after the opening of a landing door. The same ladder or another one may be used to go down into the lift car through an emergency opening fitted up in the lift roof.

b) Staff lifts

For staff lifts, it should be possible to come out the lift car and reach by means of pole steps an emergency panel. This involves installing a fixed ladder or pole steps over the entire height of the lift car roof.

Opening of the emergency panel is to provoke the lift car stopping.

Opening of the emergency panel must be possible from the inside without key.

c) Notices

Notices describing the escape routine are to be fixed:

- in the lift car
- on the car roof
- inside the well adjacent to every exit
- in the machine room.

2.4.6 Lift car

A hand rope or handrail is to be provided inside the lift car.

In compliance with [2.4.5], the lift car must have an emergency opening correctly dimensioned.

In the case of lifts for the staff, the opening should offer a free access from inside the lift car by means of a few pole steps or a ladder. The hand rope may be considered as one of these pole steps if its mechanical strength is sufficient to support the weight of a person.

The displacement of the closing panel of the emergency opening should lead to stop the lift car. This stopping should be maintained after the possible reclosing of this panel. The restarting of the lift can be carried out only after manual and intentional resetting of the safety device.

The lift car and the counterweight are to be fitted with a safety gear. Moreover, the set of the elementary loads are to be locked on its frame.

2.4.7 Pit

It must be possible to have an access to the lift pit through the lowest level landing door served by the lift car. In this case, this landing door should be fitted with a mechanical lock preventing the door from closing again, in the event where it may have been intentionally opened for cleaning or maintenance. This door can only be shut from the outside and with the help of a key specially designed for this purpose.

A mechanical device to maintain this door in an open position is to be fitted. This device should be of a particular robust construction to take into account the unit's motions.

The free distance between the bottom of the pit and the underpart of the lift car, when the lift car lies on its buffers compressed to the maximum, must be at least 0,50 m.

2.4.8 Top clearance of lift car escape

When the counterweight lies on its fully compressed buffers or, for drum drive machine, when the lift car has come to its maximum high position, the free distance above the roof of the lift car must be at least 0,75 m.

2.4.9 Normal and emergency supply circuits

Both person lifts and goods lifts are to be considered as essential auxiliaries as defined in Ch 2, Sec 1, [3.2] and should be supplied through load-shedding circuits.

2.4.10 Emergency lighting

An emergency lighting system in the lift well, the lift machine room and the lift car is to be provided. This lighting should be fed through the emergency source or through the stand-by emergency source (see Ch 2, Sec 2, [3]) in the case of lack of voltage on the main network.

2.4.11 Control and safety circuits

The alarm circuits are to trigger an audible and visual alarm to a watchkeeping room where a permanent watch is maintained.

2.4.12 Protection against external agents

Arrangements are to be made to ensure a correct ventilation of the lift car and the lift machine room.

2.4.13 Manual operation

To make up for a defect in the functioning of the electrical equipment, an operating station easily accessible is to be fitted to ensure a manual operating of the lift so as to enable the occupants of the lift car to escape.

SECTION 7 TESTS ON BOARD

1 General

1.1 Application

1.1.1 This Section covers on board tests of floating establishments. Such tests are additional to the workshop tests required in the other Sections of this Chapter.

1.2 Documentation to be submitted

1.2.1 A comprehensive list of the on board tests intended to be carried out by the Building Yard is to be submitted to the Society.

For each test, the following information is to be provided:

- scope of the test
- parameters to be recorded.

1.3 Purpose of on board tests

1.3.1 On board tests are intended to demonstrate that the machinery and associated systems are functioning properly, in respect of the criteria imposed by the Rules. The tests are to be witnessed by a Surveyor.

1.3.2 On board tests are to demonstrate the following:

a) proper operation of the machinery, including monitoring, alarm and safety systems, under realistic service conditions

b) quick and easy response to operational commands

c) detection of dangerous vibrations by taking the necessary readings when required.

d) checks either deemed necessary for unit classification or requested by the interested parties and which are possible only in the course of operation.

e) protection of the various installations, as regards:
   - the protection of mechanical parts
   - the safeguards for personnel

f) accessibility for cleaning, inspection and maintenance.

Where the above features are not deemed satisfactory and require repairs or alterations, the Society reserves the right to require the repetition of the tests, either wholly or in part, after such repairs or alterations have been carried out.

2 On board tests for machinery

2.1 Tests of diesel engines

2.1.1 General

a) The scope of the trials of diesel engines may be expanded in consideration of the special operating conditions.

b) Where the machinery installation is designed for residual or other special fuels, the ability of engines to burn such fuels is to be demonstrated.

2.1.2 Engines driving auxiliaries

a) Engines driving generators or important auxiliaries are to be subjected to an operational test for at least 2 hours. During the test, the set concerned is required to operate at its rated power for at least 1 hours.

b) It is to be demonstrated that the engine is capable of supplying 100% of its rated power and, in the case of shipboard generating sets, account is to be taken of the times needed to actuate the generator's overload protection system.

2.2 Tests of piping systems

2.2.1 Hydrostatic tests of piping after assembly on board

a) When the hydrostatic tests of piping according to Ch 1, Sec 3, [6] are carried out on board, they may be carried out in conjunction with the leak tests required in [2.2.2].

b) Low pressure pipes, such as bilge or ballast pipes are to be tested, after fitting on board, under a pressure at least equal to the maximum pressure to which they can be subjected in service. Moreover, the parts of such pipes which pass, outside pipe tunnels, through compartments for ballast water, fresh water, or fuel, are to be fitted before the hydraulic test of the corresponding compartments.

c) Heating coils in oil fuel tanks and fuel pipes are to be subjected, after fitting on board, to a hydraulic test under a pressure not less than 1,5 times the design pressure, with a minimum of 4 bars.

2.2.2 Leak tests

Except otherwise permitted by the Society, all piping systems are to be leak tested under operational conditions after completion on board.

2.2.3 Functional tests

During trials, piping systems serving machinery, including the associated monitoring and control devices, are to be subjected to functional tests at the nominal power of the machinery. Operating parameters (pressure, temperature, consumption) are to comply with the values recommended by the equipment manufacturer.

2.2.4 Performance tests

The Society reserves the right to require performance tests, such as flow rate measurements, should doubts arise from the functional tests.

3 Inspection of machinery after trials

3.1 General

3.1.1 For all types of machinery, those parts which have not operated satisfactorily in the course of the trials, or which have caused doubts to be expressed as to their proper operation, are to be disassembled or opened for inspection.

Machinery or parts which are opened up or disassembled for other reasons are to be similarly inspected.

3.1.2 Should the inspection reveal defects or damage of some importance, the Society may require other similar machinery or parts to be opened up for inspection.

3.1.3 An exhaustive inspection report is to be submitted to the Society.

3.2 Diesel engines

3.2.1 In general, for all diesel engines, the following items are to be verified:

- the deflection of the crankshafts
- the cleanliness of the lubricating oil filters.

3.2.2 In the case of diesel engines for which power tests have not been carried out in the workshop, some parts, agreed upon by the interested parties, are to be disassembled for inspection after the trials.

Part C
Machinery, Systems and Electricity

Chapter 2
ELECTRICAL INSTALLATIONS

SECTION 1 GENERAL REQUIREMENTS

1 Application

1.1 General

1.1.1 The requirements of this Chapter apply to electrical installations on board floating units. In particular, they apply to the components of electrical installations for:

- primary essential services
- secondary essential services
- essential services for special purposes connected with units specifically intended for such purposes (e.g. air conditioning systems)
- services for habitability.

The other parts of the installation are to be so designed as not to introduce any risks or malfunctions to the above services.

1.1.2 Equipment and systems not covered by this Chapter are to comply with the applicable requirements of NR217, Pt C, Ch 2.

1.2 References to other regulations and standards

1.2.1 Besides these Rules, electrical equipment shall meet a standard approved by the Society, such as IEC and EN.

1.2.2 When referred to by the Society, publications by the International Electrotechnical Commission (IEC) or other internationally recognised standards, are those currently in force at the date of agreement for the unit classification.

2 Documents to be submitted

2.1 Documents

2.1.1 The drawings and documents listed below are to be submitted to the Society for review/approval in sufficiently good time to enable them to be reviewed/approved and made available to the Building Yard and the Surveyor by the time the manufacture or installation of the electrical equipment begins.

Where non-standard symbols are used in circuit and wiring diagrams, a legend explaining the symbols is to be provided.

All documents for review/approval shall bear the yard number and the name of the shipbuilder.

The Society reserves the right to call for additional documents and drawings should those stipulated in [2.1.2] to [2.1.7] prove insufficient for an assessment of the plant.

2.1.2 Details of the nature and extent of the electrical installations including the power balance (electrical balance).

2.1.3 A general circuit diagram of the electrical plant showing the basic configuration of the power distribution system with details of the power ratings of generators, converters, transformers, storage batteries and all major consumers.

2.1.4 Cable layout or tabulated list of cables showing cable sections and types as well as generator and consumer loads (currents).

2.1.5 Circuit diagrams for:

- main switchgear installations
- emergency switchgear installations (where applicable)
- spaces with an explosion hazard with details of installed equipment
- lighting system
- signalling light system.

2.1.6 Circuit diagrams of control, alarm and monitoring installations, where applicable, such as:

- alarm systems
- fire alarm systems
- tank level indicators, alarms, shut-off facilities
- gas detector systems
- emergency shut-off facilities
- watertight door control systems
- computer systems
- communication systems.

2.1.7 Installation plan

The plan is to provide details of the exact location of the switchboard, the size of service passageways, distances from bulkheads and frames etc.

3 Definitions

3.1 Control station

3.1.1 A control station is a dedicated space or an area of a service space which contains safety and control equpment such as:

- emergency electrical power plant or parts thereof
- control and monitoring equipment for machinery installations
- fire alarm equipment
- remote control of doors or dampers.

A control station shall be installed in a location not accessible to the public and supervised during hours of operation of the floating etablishment.

A control station shall be visible to staff and its controls and signaling shall remain accessible.

3.2 Essential services

3.2.1 Essential services are defined in Pt A, Ch 1, Sec 1, [1.2.5]. They are subdivided in primary and secondary essential services.

3.3 Primary essential services

3.3.1 Primary essential services are those which need to be in continuous operation to maintain service.

Examples of equipment for primary essential services are the following:

- Scavenging air blowers, fuel oil supply pumps, lubricating oil pumps and cooling water pumps for diesel engines
- Electric generators and associated power sources supplying the above equipment
- Hydraulic pumps supplying the above equipment
- Control, monitoring and safety devices/systems for equipment for primary essential services

The main lighting system for those parts of the unit normally accessible to and used by public and staff is also considered (included as) a primary essential service.

3.4 Secondary essential services

3.4.1 Secondary essential services are those services which need not necessarily be in continuous operation.

Examples of equipment for secondary essential services are the following:

- Starting air and control air compressors
- Bilge pumps
- Fire pumps and other fire-extinguishing medium pumps
- Ventilation fans for engine rooms
- Signalling lights
- Internal safety communication equipment
- Fire detection and alarm systems
- Electrical equipment for watertight closing appliances
- Electric generators and associated power supplying the above equipment
- Hydraulic pumps supplying the above equipment
- Control, monitoring and safety devices/systems for equipment for secondary essential services.

3.5 Services for habitability

3.5.1 Services for habitability are those intended for minimum comfort conditions for people on board. Examples of equipment for maintaining conditions of habitability:

- cooking
- heating
- domestic refrigeration
- mechanical ventilation
- sanitary and fresh water
- electric generators and associated power sources supplying the above equipment.

3.6 Earthing

3.6.1 The earth connection to the general mass of the hull of the unit in such a manner as will ensure at all times an immediate discharge of electrical energy without danger.

3.7 Emergency condition

3.7.1 A condition under which any services needed for normal operational and habitable conditions are not in working order due to failure of the main source of electrical power.

4 General design requirements

4.1 Environmental conditions

4.1.1 Inclinations - Ambient conditions

All electrical machinery, appliances, cables and accessories are to be selected, designed and constructed for satisfactory performance under the conditions stated in Tab 1 and Tab 2.

Where other conditions are likely proper account shall be taken of these.

Table 1 : Permanent inclination of unit

Installations, components	Angle of inclination (degrees) **(1)**	
	List	Trim
Auxiliary machinery	12	5
(1) List and trim may occur simultaneously.		

Table 2 : Ambient conditions

AIR TEMPERATURE	
Location, arrangement	Temperature range (°C)
In enclosed spaces	between 0 and +40 (+45 in tropical zone)
On machinery components, boilers In spaces subject to higher or lower temperatures	According to specific local conditions
On exposed decks	between -20 and +40 (+45 in tropical zone)

WATER TEMPERATURE	
Coolant	Temperature (°C)
River water or, if applicable, river water at charge air coolant inlet	up to +25 in general up to +32 in tropical zone

4.1.2 Vibrations

Electrical machines and appliances shall be so constructed and installed that they will not be damaged by the vibrations and shaking occurring in normal on board service.

The natural frequencies of foundations, fastenings and suspensions for machines, appliances and electrical components (including those inside appliances) shall not lie within the frequency range 5 - 100 Hz.

If, for reasons of design, the natural frequency has unavoidably to lie within the aforementioned frequency range, the accelerations are to be sufficiently damped to exclude the likelihood of malfunctions or damage.

4.2 Quality of power supply

4.2.1 All the electrical appliances used on board shall be so designed and constructed that they remain serviceable despite the voltage and frequency variations occurring in normal on board service. Unless otherwise specified, considerations may be based on the variations shown in Tab 3.

Networks or sub-networks with greater voltage variations may be approved for consumers intended for operation with greater variations.

Table 3 : Voltage and frequency variations

	Variable	Variations	
		Permanent	Transient
General	Frequency Voltage	± 5% + 6% - 10%	± 10% 5s ± 20% 1,5s
Battery operation	Voltage	± 20%	-

4.2.2 In equipment with electronic frequency converters, the voltage waveform may deviate from that specified in Ch 2, Sec 2, [4.2.1] provided that measures are taken to ensure that this does not interfere with the operation of consumers or other equipment such as radio and operation facilities.

If necessary, converters or similar means should be used for separation from the mains.

4.2.3 Harmonic distorsion

The total harmonic distortion shall be less than or equal to 5%.

4.3 Materials

4.3.1 The materials used for the construction of electrical machines, cables and appliances shall be resistant to moist air and oil vapours. They shall not be hygroscopic and shall be flame-retardant. The dimensions of minimum creep distances and air clearances are to conform to IEC 60664-1 or EN 60664-1. Relaxations may be allowed for installations up to 50 V.

4.4 Protective measures

4.4.1 Protection against shock and water

The type of protection or enclosure of every machine and every other item of equipment shall be compatible with the site where it is installed. The particulars in Tab 4 are minimum requirements.

Table 4 : Minimum degrees of protection

Type of space	Minimum type of protection (in accordance with IEC Publication 60529)							
	Generators	Motors	Transformers	Switchboards, consoles, distribution boards	Measuring instruments	Switchgear	Installation material	Lamp fittings
Service spaces and machinery spaces	IP 22	IP 22	IP 22	IP 22 **(1)**, **(4)**	IP 22	IP 22 **(1)**, **(4)**	IP 44	IP 22
Refrigerated holds		IP 44		IP 44		IP 44	IP 55	IP 55
Storage battery, paint storage and lamp room								IP 44 **(5)** and (EX)
Ventilating trunks(deck)		IP 44					IP 55	
Exposed deck		IP 55 **(3)**		IP 55 **(3)**	IP 55 **(3)**	IP 55 **(3)**	IP 55 **(3)**	IP 55
Closed control station		IP 22	IP 22	IP 22	IP 22	IP 22	IP 22	IP 22
Accommodation and public rooms				IP 22			IP 20 IP 55 **(2)**	IP 20
Sanitary facilities and commissary spaces		IP 44	IP 44	IP 44			IP 55	IP 44

(1) IP 12 for appliances generating a large amount of heat.
(2) Where laid behind ceiling.
(3) IP 56 for appliances subject to flooding.
(4) Where the class of protection is not provided by the appliance itself, the site at which it is installed must have the level of protection stated in the Table.
(5) Electrical appliance of certified safety, e.g. in accordance with IEC Publication 60079 or EN 50014-50020.

4.4.2 Protection against electric shock: direct contact

Protection against direct contact includes all the measures designed to protect persons against the dangers arising from contact with live parts of electrical appliances. Live parts are deemed to be conductors and conductive parts of appliances which are live under normal operating conditions.

Electrical appliances shall be so designed that the person cannot touch or come dangerously close to live parts, in way of the determined operation.

Protection against direct contact may be dispensed with in the case of equipment using safety voltage.

In service spaces, live parts of the electrical appliances shall remain protected against accidental contact when doors and covers which can be opened without a key or tool are opened for operation purposes.

4.4.3 Protection against electric shock: indirect contact

Electrical appliances shall be made in such a way that persons are protected against dangerous contact voltages even in the event of an insulation failure.

For this purpose, the construction of the appliances shall incorporate one of the following protective measures:

- Protective earthing (see [4.4.4])
- Protective insulation (double insulation)
- Operation at very low voltages presenting no danger even in the event of a fault.

The additional usage of Residual Current Protective Devices is allowed.

4.4.4 Protective earthing

Metal casings and all metal parts accessible to touch which are not live in normal operation but may become so in the event of a fault are to be earthed except where their mounting already provides a conductive connection to the unit's hull.

Special earthing may be dispensed with in the case of:

a) metal parts insulated by a non-conductor from the dead or earthed parts

b) bearings of electrical machines which are insulated to prevent currents flowing between them and the shaft

c) electrical equipment whose service voltage does not exceed 50 V.

Where machines and equipment are earthed to the hull via their mountings, care is to be taken to ensure good conductivity by clean metal contact faces at the mounting. Where the stipulated earth is not provided via the mountings of machinery and equipment, a special earthing conductor is to be fitted for this purpose.

For the earthing of metal sheaths, armouring and cable braiding, see Ch 2, Sec 11, [15.1.4].

Protection shall be provided by an additional cable, an additional lead or an additional core in the power cable.

Metal cable armouring may not be used as an earthing conductor.

A conductor normally carrying current may not be used simultaneously as an earthing conductor and may not be connected with the latter by a common connection to the vessel's hull.

The cross-section of the earthing conductor shall be at least in accordance with Tab 5.

The connections of earthing conductors to the metal parts to be earthed and to the vessel's hull are to be made with care and are to be protected against corrosion.

Electrical equipment in the area subject to explosion hazard is in every case to be fitted with an earthing conductor irrespective of the type of mounting used.

Table 5 : Cross-section of earthing conductors

Cross-section of main conductors, in mm^2	Minimum cross-section of earthing conductor	
	Earthing conductor incorporated in the cable, in mm^2	Earthing conductor separated from the cable, in mm^2
0,5 up to 4	Equal to the main conductor	4
> 4 up to 16	Equal to the main conductor	Equal to the main conductor
> 16 up to 35	16	16
> 35 up to 120	Equal to the half main conductor	Equal to the half main conductor
> 120	70	70

4.4.5 Explosion protection: hazardous areas, zone 0

These areas include for instance the insides of tanks and piping with a combustible liquid with a flash point ≤ 60°C, or inflammable gases.

For electrical installations in these areas the permitted equipment that may be fitted is:

- Intrinsically safe circuits Ex ia
- Equipment specially approved for use in this zone by a test organisation recognised by the Society.

4.4.6 Explosion protection: hazardous areas, zone1

These areas include e.g.:

- paint rooms
- storage battery rooms
- areas with machinery, tanks or piping for fuels with a flash point below 60°C, or inflammable gases, see [4.4.10]
- ventilation trunks.

Areas subject to explosion hazard zone 1 also include tanks, vessels, heaters, pipelines etc. for liquids or fuels with a flash point over 60°C, if these liquids are heated to a temperature higher than 10°C below their flash point.

Electrical equipment shall not be installed or operated in areas subject to explosion hazard, with the exception of explosion-protected equipment of a type suitable for on board use. Electrical equipment is deemed to be explosion-protected, if they are manufactured to a recognized standard such as IEC 60079 publications or EN 50014-50020, and if they have been tested and approved by a testing authority recognized by the Society. Notes and restrictions at the certificate have to be observed.

Certified safe type equipment listed in Tab 6 is permitted.

Cables in hazardous areas zone 1 shall be armoured or screened, or run inside a metal tube.

Table 6 : Certified safe type equipment

intrinsic safety	Ex i
flameproof enclosure	Ex d
pressurized apparatus	Ex p
increased safety	Ex e
special type of protection	Ex s
oil immersion	Ex o
encapsulation	Ex m
sand filled	Ex q

4.4.7 Explosion protection: extended hazardous areas, zone 2

Areas directly adjoining Zone 1 lacking gastight separation from one another are allocated to Zone 2.

For equipment in these areas protective measures are to be taken which, depending on the type and purpose of the facility, could comprise e.g.:

- use of explosion-protected facilities, or
- use of facilities with type Ex n protection, or
- use of facilities which in operation do not cause any sparks and whose surfaces, which are accessible to the open air, do not attain any unacceptable temperatures, or
- facilities which in a simplified way are overpressure-encapsulated or are fumetight-encapsulated (minimum protection type IP 55) and whose surfaces do not attain any unacceptable temperatures.

4.4.8 Explosion protection: electrical equipment in paint rooms

In the above-mentioned rooms (Zone 1) and in ventilation ducts supplying and exhausting these areas, electrical equipment shall be of certified type as defined in [4.4.6] and comply at least with II B, T3.

Switches, protective devices and motor switchgear for electrical equipment in these areas shall be of all-poles switchable type and shall preferably be fitted in the safe area.

Doors to paint rooms have to be gastight with self-closing devices without holding back means.

4.4.9 Protective measures in the case of ignitable dust

Only lighting fittings with IP 55 protection, as a minimum requirement, may be used in areas where ignitable dusts may be deposited.

In continuous service, the surface temperature of horizontal surfaces and surfaces inclined up to 60° to the horizontal shall be at least 75 K below the glow temperature of a 5 mm thick layer of the dust.

4.4.10 Explosion protection: Pipe tunnels

All equipment and devices in pipe tunnels containing fuel lines or adjoining fuel tanks shall be permanently installed irrespective of the flash point of the fuels. Where pipe tunnels directly adjoin tanks containing combustible liquids with a flash point below 60°C, e.g. in ore or oil carriers, or where pipes inside these tunnels convey combustible liquids with a flash point below 60°C, all the equipment and devices in pipe tunnels shall be certified explosion-protected in accordance with [4.4.6] (zone 1).

4.4.11 Amount of electrical facilities

Amount and ignition protection of approved electrical equipment in zones 0,1 and 2 may be restricted in the different areas where they are used. The relevant current construction Rules have to be observed for this reason.

4.4.12 Batteries room

See Ch 2, Sec 5.

4.4.13 Electromagnetic compatibility (EMC)

Where necessary, appropriate measures shall be taken to avoid interference due to electromagnetic energy.

This applies especially to radio equipment and electronic appliances.

Details are contained in IEC 60533.

5 Supply systems and characteristics of the supply

5.1 Supply systems

5.1.1 As a general principle, systems listed in [5.1.2] to [5.1.4] are permitted.

5.1.2 For direct current and single-phase alternating current:

a) 2 conductors, one of which is earthed
b) Single conductors with hull return, restricted to systems of limited extent (e.g. starting equipment of internal combustion engines and cathodic corrosion protection)
c) 2 conductors insulated from the unit's hull.

5.1.3 For 3-phase alternating current:

a) 4 conductors with earthed neutral and no hull return
b) 3 conductors insulated from the hull
c) 3 conductors with hull as neutral conductor, however, not in final subcircuits.

5.1.4 Other systems have to be approved by the Society in each case.

5.1.5 Systems using the hull as neutral conductor are not permitted on units whose hull can be dismantled.

5.2 Characteristics of the supply

5.2.1 General

The use of standard voltages and frequencies is recommended.

Generators may have rated voltages up to 5% higher than the rated voltage of the consumers.

5.2.2 Maximum voltages

The operating voltages indicated in Tab 7 may not be exceeded.

In special installations (e.g. radio equipment and ignition equipment) higher voltages are permitted subject to compliance with the necessary safety measures.

6 Type approvals

6.1 General

6.1.1 The installations, equipment and assemblies mentioned in [6.1.5] are subject to mandatory type approval.

6.1.2 Type tests shall be carried out in the presence of Society's Surveyor either in the manufacturer's works or, by agreement, in suitable institutions.

6.1.3 Type tests are carried out according to the Society's Rules for approval of equipment.

6.1.4 Type tested installations, apparatuses and assemblies shall be used within the scope of valid construction Rules only. The suitability for the subject application shall be ensured.

6.1.5 Installations, equipment and assemblies subject to type testing

Following installations, equipment and assemblies are subject to type approval:

a) Generators, power ≥ 50 kw/kva

b) Electrical machines, power ≥ 50 kw/kva

c) Transformers, power ≥ 50 kw/kva

d) Storage battery chargers, power ≥ 2 kw

e) Switchgear

f) Cables and insulated wires

g) Control, monitoring, alarm and safety systems

h) Power electronics, power ≥ 50 kw/kva

i) Computer systems: class 3, 4 and 5.

Exceptions to this requirement compatible with the statutory Regulations of the unit's country of registration may be agreed with the Society.

6.2 Exceptions

6.2.1 Instead of the stipulated type approvals in well-founded cases routine tests in the presence of a Surveyor may be carried out. An agreement with the Society prior to testing is required.

Table 7 : Maximum permissible operating voltages

Type of installation	Maximum permissible operating voltage		
	DC	1-phase AC	3-phase AC
Power and heating installations including the relevant sockets	250 V	250 V	500 V
Lighting, communications, command and information installations including the relevant sockets	250 V	250 V	-
Sockets intended to supply portable devices used on open decks or within narrow or damp metal lockers, apart from boilers and tanks:			
• In general	50 V **(1)**	50 V **(1)**	-
• Where a protective circuit-separation transformer only supplies one appliance	-	250 V **(2)**	-
• Where protective-insulation (double insulation) appliances are used	250 V	250 V	-
• Where ≤ 30 mA default current circuit breakers are used.	-	250 V	500 V
Mobile power consumers such as electrical equipment for containers, motors, blowers and mobile pumps which are not normally moved during service and whose conducting parts which are open to physical contact are grounded by means of a grounding conductor that is incorporated into the connecting cable and which, in addition to that grounding conductor, are connected to the hull by their specific positioning or by an additional conductor	250 V	250 V	500 V
Sockets intended to supply portable appliances used inside boilers and tanks	50 V **(1)**	50 V **(1)**	-

(1) Where that voltage comes from higher voltage networks galvanic separation shall be used (safety transformer).
(2) All of the poles of the secondary circuit shall be insulated from the ground.

SECTION 2 DESIGN AND CONSTRUCTION OF POWER GENERATING PLANT

1 Main power supply

1.1 Units assigned additional service feature "Autonomous"

1.1.1 On floating establishments assigned the additional service feature **Autonomous**, at least two separate independent main generator plants are to be provided for the supply to the electrical equipment. The prime mover system and the generator output shall be such that, if any generator set fails or is taken out of service, the remaining capacity is sufficient to meet the unit operation requirements.

1.2 Units not assigned additional service feature "Autonomous"

1.2.1 Shore-supplied units

The rating of the shore supply system is to be adequate for the operation electrical load of the unit.

The quality of the shore supply system is to be documented. The voltage and frequency variations of the power supply given in Ch 2, Sec 1, [4.2] are to be complied with.

The harmonic distorsion defined in Ch 2, Sec 1, [4.2.3] is not to be exceeded.

1.2.2 Self-supplied units

On self-supplied floating establishments not assigned the additional service feature **Autonomous**, at least one main generator plant is to be provided for the supply to the electrical equipment.

2 Power balance

2.1 Power requirements

2.1.1 A power balance for the electrical plant shall be furnished as proof that the generator rating is sufficient.

The power requirements are to be determined for day/night running service and emergency supply, if any.

A table is to be compiled listing all the installed electrical consumers together with their individual power ratings:

a) Account is to be taken of the full power rating of those consumers permanently required for the operation of the unit.

b) The installed capacity of consumers kept in reserve is to be listed. The consumption of those consumers which operate only following the failure of a unit of the same kind need not be included in the calculation.

c) The aggregate power consumption of all consumers intermittently connected to the supply is to be multiplied by a common simultaneity factor and the result added to the sum of the permanently connected consumers.

   The simultaneity factor may be applied only once in the course of the calculation.

Consumers with a relatively high power consumption are to be included in the calculation at their full rating even though they may be used only intermittently.

The sum of the loads represented by a) and c), with due allowance for the battery charging capacity, is to be used when deciding the generator rating.

Unless some other standby capacity such as a floating battery is available, some spare capacity is to be designed into the system to cover short-lived peak loads like those caused by the automatic start-up of large motors.

3 Emergency power supply

3.1 General

3.1.1 An emergency source of electrical power independent of the main power supply is to be provided which is capable of feeding the electrical systems and consumers essential to the safety of public and staff. The feeding time depends on the purpose of the unit and should be agreed with the national Authority, but shall not be less than half an hour. The power supply to the following systems is especially relevant to the safety of public and staff:

a) signalling lights

b) sound devices such as tyfon

c) emergency lighting

d) radio installations

e) alarm systems for unit's safety

f) public address system (general alarm)

g) telecommunication systems essential to safety and the operation of the unit

h) fire detection system

i) sprinkler systems and other safety installations.

3.2 Emergency source

3.2.1 The following are admissible for use as an emergency power source:

a) auxiliary generator sets with their own independent fuel supply and independent cooling system which, in the event of a power failure, turn on and take over the supply of power within 30 seconds automatically or, if they are located in the immediate vicinity of the location permanently manned by staff, can be turned on manually, or

b) storage batteries, which, in the event of a power failure, turn on automatically or, if they are located in the immediate vicinity of the location permanently manned by staff, can be turned on manually. They shall be capable of powering the abovementioned power consumers throughout the prescribed period without recharging and without an unacceptable voltage reduction.

3.3 Installation

3.3.1 Emergency generator sets, emergency storage batteries and the relevant switchgear are to be installed outside the machinery space, the machinery casings and the main generator room. They are to be separated from these spaces by fire retardant and watertight bulkheads so that the emergency power supply will not be impaired in the event of a fire or other accident in the machinery space.

Facilities are to be provided for the periodical operational testing of all items of equipment serving the emergency power supply system including especially the automatic switchgear and starting equipment. Such tests must be possible without interference with other aspects of the unit's operation.

4 Generator ratings control

4.1 DC generators

4.1.1 The following may be used to supply DC on board networks:

- Regulated single or 3-phase AC generators connected to a rectifier
- Compound-wound generators
- Shunt generators with automatic voltage regulator.

4.1.2 Generators shall be designed so that, even with the battery disconnected, their voltage characteristic and harmonic content remain within the prescribed limits over the whole load range and they themselves suffer no damage. They should be so designed that a short circuit at the terminals produces a current not less than three times the rated current. They shall be able to withstand the sustained short-circuit current for 1 second without suffering damage. Exemptions from these requirements may be granted subject to proof in each instance that the selective disconnection of short circuits in the unit's network is assured at even lower sustained short-circuit currents, possibly in conjunction with a parallel-connected power supply battery.

The regulator characteristic of the generators shall ensure that connected power supply batteries are without fail fully charged over the whole load range and overcharging is avoided.

4.2 Single and 3-phase AC generators

4.2.1 Generator design

The apparent output of 3-phase generators shall be rated such that no unacceptable voltage dips occur in the on board supply as a result of the starting currents affecting normal operation. On no account may the start-up of the motor with the greatest starting current give rise to an undervoltage causing consumers already in service to cut out.

The waveform of the no-load phase-to-phase voltage should be sinusoidal as far as possible. The deviation from the sinusoidal fundamental wave should at no time be greater than 5% in relation to the peak value of the fundamental wave.

The root-mean-square (r.m.s.) values of the phase voltage with symmetrical loading shall not vary from each other by more than 0,5%.

If the neutral points of generators running in parallel are connected, the waveforms of the phase voltages should coincide as nearly as possible. The use of generators of the same type is recommended. As a general principle, it is necessary to ensure that the equalizing current determined by the harmonic content does not exceed 20% of the rated current of the machine with the lowest capacity.

The generators and their exciters are to be so designed that for two minutes the generator can be loaded with 150% of its rated current with an inductive power factor of 0,5 while approximately maintaining the rated voltage. Generators may suffer no damage as a result of a short-circuit and the short circuits which may occur in the supply network in later service. The design shall take account of the short time delay of the generator switches which is necessary to the selectivity of the system and during which the short-circuit current is sustained.

With voltage-regulated generators it is necessary to ensure that an input data failure cannot lead to unacceptable high terminal voltages.

4.2.2 Conditions

Under balanced load conditions, 3-phase alternators and their exciters are required to meet the following conditions:

a) Steady conditions

When the alternator is operated with the associated prime mover, the voltage shall not deviate from the rated value by more than ± 2,5% from no-load up to the rated output and at the rated power factor after the transient reactions have ceased. For this purpose the prime mover shall be set to its rated speed at rated output.

b) Transient control conditions

With the generator running at rated speed and rated voltage, the voltage shall not deviate below 85% or above 120% of its rated value as the result of the sudden connection or disconnection of balanced loads with a specified current and power factor. It shall regulate within the limits stated in a) in not more than 1,5 seconds. Under test conditions, the generator may in this connection be driven at practically constant speed, e.g. by a suitable electric motor.

Unless the client specifies particular load changes, the above requirements are to be satisfied under the following conditions:

The idling generator, excited to its rated voltage, is to be suddenly connected to a load equal to 60% of its rated current with a (lagging) power factor not greater than 0,4. Once steady-state control conditions have been attained, the load is to be suddenly disconnected.

c) Sustained short-circuit current

The sustained short-circuit current at a single, two or 3-phase terminal short shall not be less than three times the rated current. The generator and its exciter shall be able to carry the sustained short-circuit current for a period of one second without suffering damage.

Exemptions from these requirements may be granted subject to proof in each instance that the selective disconnection of short circuits in the unit's network is assured at even lower sustained short-circuit currents.

4.2.3 Three-phase AC generators for parallel operation

Where generators of the same output are run in parallel with the active load shared equally, the reactive power of each machine shall not deviate from its percentage share by more than 10% relative to its rated reactive power.

Where the generators differ in output, the deviation from the proportional share within the aforementioned load range shall not exceed the smaller of the following values, assuming proportionally equal sharing of the active load:

a) 10% of the rated reactive power of the largest machine

b) 25% of the rated reactive power of the smallest machine.

5 Generator prime movers

5.1 Design and control

5.1.1 The design and control of generator prime movers are to conform to Ch 1, Sec 2, construction rule requirements for diesel engines.

5.2 Parallel operation

5.2.1 The governing characteristics of prime movers in the case of single or 3-phase alternator sets of the same output operating in parallel shall ensure that, over the range from 20% to 100% of the total active power, the share of each machine does not deviate from its proportionate share by more than 15% of its rated active power.

Where the units are differently rated, the deviation from the proportionate share within the load range stated shall not exceed the lesser of the following values:

a) 15% of the rated active power of the largest machine

b) 25% of the rated active power of the smallest machine.

5.3 Cyclic irregularity

5.3.1 The permissible cyclic irregularity is to be agreed upon between the prime mover and generator manufacturers. The following has to be ensured:

a) Faultless parallel operation of 3-phase generators

b) Regular or irregular load variations shall not give rise to fluctuations in active power output exceeding 10% of the rated output of the machine concerned

c) Practically non-flicker lighting at all working speeds.

6 Special rules

6.1 General

6.1.1 Notwithstanding the conditions set out above, other speed and control characteristics may be approved for generators with outputs of up to 10 kW (kVA) provided that troublefree operation remains assured.

Where generators are backed up by floating batteries it is necessary to ensure that the absence of the battery voltage cannot damage the generators and controllers.

SECTION 3 ELECTRICAL MACHINES

1 Construction

1.1 General

1.1.1 Unless otherwise stated in this Section, all motors and generators shall conform to a standard accepted by the Society.

1.1.2 In conjunction with the protective equipment to be provided, generators shall be capable of withstanding the dynamic and thermal stresses produced by a short circuit. All machines are to be so designed and constructed that the permissible temperature rises stated in Tab 1 are not exceeded.

The insulation classes have to correspond to the ratings IEC 60085.

In the case of laminated insulations, the highest temperature permitted for each individual insulating material shall not be exceeded.

All windings shall be effectively protected against the effects of moist or salty air and oil vapours.

On DC machines, the commutating pole windings are to be connected symmetrically to the armature, wherever possible. Anti-interference capacitors are to be connected directly to the armature terminals. Anti-interference capacitors on generators shall have built-in cutouts.

1.1.3 The carbon brushes shall be compatible with the slipring and commutator materials and, in the case of the latter, with the commutating conditions.

The working position of the brushholder is to be clearly marked.

1.1.4 The terminals shall be located in an easily accessible position and shall be dimensioned to suit the cross-section of the cables to be connected. The terminals are to be clearly marked.

The class of protection shall match that of the machine and shall be at least IP 44.

Exceptions to this Rule may be permitted for machines with a working voltage of ≤ 50 V.

1.1.5 The manufacturer shall provide every generator and motor with a name and data plate containing the machine's serial number and all essential operating data.

1.1.6 Commutators, sliprings and, wherever possible, windings shall be easily accessible for the purposes of inspection, maintenance and repair. On larger machines with plain bearings it shall be possible to check the air gap.

2 Testing of electrical machines

2.1 Workshop certificates

2.1.1 For generators and electrical motors with rated power less than 50 kVA or 50 kW, which have not been tested in the presence of a Surveyor, workshop certificates are to be submitted.

2.2 Scope of tests

2.2.1 Temperature rise test (heat test)

a) A heat test shall be performed until the steady-state temperature corresponding to the required mode of operation is reached. The steady-state temperature pass for reached when the temperature rises by not more than 2 K per hour.

   Machines with separate cooling fans, air filters and heat exchangers shall be tested together with this equipment. The heat run shall be completed with the determination of the temperature rise. The maximum permissible values shown in Tab 1 shall not be exceeded.

b) An extrapolation of the measured values to the disconnection time (t = 0) is not necessary if the reading takes place within following periods:

   - up to 50 kVA/kW 30 s
   - over 50 up to 200 kVA/kW 90 s
   - over 200 up to 5000 kVA/kW 120 s

c) Heat tests on machines of identical construction made not more than 3 years previously can be recognized.

   The referenced temperature rise shall be at least 10% lower than that listed in Tab 1.

The following tests shall be carried out at approximately normal operating temperatures.

2.2.2 Load characteristics

On generators the voltage and on motors the speed is measured as a function of the applied load.

2.2.3 Overload test

a) For generators:

   1,5 times the rated current for two minutes

b) For standard motors:

   1,6 times the rated torque for 15 seconds. During the test, the motor speed may not drop below its pull out speed

Table 1 : Permitted temperature-rises of air cooled machines at an ambient temperature of 40°C (difference values in K)

N°	Machinery component		Method of measurement **(3)**	Insulation class				
				A	E	B	F **(1)**	H **(1)**
1	AC windings of machines		R	60	75	80	105	125
2	Commutator windings		R	60	75	80	105	125
3	Field windings of AC and DC machines with DC excitation, other than those specified under 4		R	60	75	80	105	125
4	a) Field windings of synchronous machines with cylindrical rotors having DC excitation winding, embedded in slots except synchronous induction motors		R	-	-	90	110	130
	b) Stationary field windings of DC machines having more than one layer		R	60	75	80	105	125
	c) Low-resistance field windings of AC and DC machines and compensation windings of DC machines having more than one layer		R Th	60	75	80	100	120
	d) Single-layer field windings of AC and DC machines with exposed bare or varnished metal surfaces and single-layer compensation windings of DC machines		R Th	60	80	90	110	130
5	Permanently short-circuited, insulated windings		Th	60	75	80	100	120
6	Permanently short-circuited, uninsulated windings		The temperature rises of these parts shall in no case reach such values that there is a risk of injury to any insulation or other material on adjacent parts or to the item itself					
7	Iron cores and other parts not in contact with windings							
8	Iron cores and other parts in contact with windings		Th	60	75	80	100	120
9	Commutators and slip rings, open or closed		Th	60	70	80	90	110
10	Plain bearings	measured in the lower bearing shell or in the oil sump after shutdown		50				
11	Roller bearings Roller bearings with special grease	measured in the lubrication nipple bore or near the outer bearing seat		50 80				
12	Surface temperature			Reference 40 **(2)**				

(1) The values may need correction in the case of high-voltage AC windings

(2) Higher temperature rises may be expected on electrical machines with insulation material for high temperatures. Where parts of such machinery may be accidentally touched and there is a risk of burns (> 80°C), the Society reserves the right to request means of protection such as a handrail to prevent accidental contacts

(3) R = resistance method
Th = thermometer method

2.2.4 Short-circuit test on 3-phase AC generators

a) On all synchronous generators, the steady short-circuit current shall be determined with the exciter unit in operation (see Ch 2, Sec 2, [4.2.2] c).

b) A short-circuit withstand test may be demanded:
   - to determine the reactances
   - if there is any concern regarding mechanical and electrical strength.

   Synchronous generators which have undergone a short-circuit withstand test shall be thoroughly examined after the test for any damage.

2.2.5 High-voltage test (winding test)

a) The test voltage shall be as shown in Tab 2.

   It shall be applied for one minute for each single test. The voltage test shall be carried out between the windings and the machine housing, the machine housing being connected to the windings not involved in the test. This test shall be performed only on new, fully assembled machines fitted with all their working parts. The test voltage shall be a practically sinusoidal AC voltage at system frequency.

   The maximum anticipated no-load voltage or the maximum system voltage is to be used as reference in determining the test voltage.

b) Any repetition of the voltage test which may be necessary shall be performed at only 80% of the nominal test voltage specified in Tab 2.

Table 2 : Test voltages for the winding test

N°	Machine or machinery component	Test voltage (r.m.s) dependent on rated voltage U of the subject winding, in V
1	Insulated windings of rotating machines of output less than 1 kW (kVA), and of rated voltages less than 100 V with the exception of those in items 3 to 6	2U + 500
2	Insulated windings of rotating machines with the exception of those in item 1 and items 3 to 6	2U + 1000, with a minimum of 1500
3	Separately excited field windings of DC machines	1000 + twice the maximum excitation voltage but not less than 1500
4	Field windings of synchronous generators, synchronous motors and rotary phase converters: a) Rated field voltage up to 500 V over 500 V	 10 times the rated voltage, with a minimum of 1500 4000 + twice rated field voltage
	b) When a machine is intended to be started with the field winding short-circuited or connected across a resistance of value less than ten times the resistance of the winding	10 times the rated field voltage, minimum 1500, maximum 3500
	c) When a machine is intended to be started either with the field winding connected across a resistance of value equal to or more than ten times the resistance of the winding, or with the field windings on open-circuit with or without a field dividing switch	1000 + twice the maximum value of the r.m.s. voltage, which can occur under the specified starting conditions, between the terminals of the field winding, or in the case of a sectionalized field winding between the terminals of any section, with a minimum of 1500
5	Secondary (usually rotor) windings of induction motors or synchronous induction motors if not permanently short-circuited (e.g. if intended for rheiostatic starting) a) for non-reversing motors or motors reversible from standstill only	1000 + twice the open-circuit standstill voltage as measured between slip rings or secondary terminals with rated voltage applied to the primary windings
	b) for motors to be reversed or braked by reversing the primary supply while the motor is running	1000 + four times the open circuit secondary voltage as defined in item 5a)
6	Exciters (exception below) a) Exception 1 Exciters of synchronous motors (including synchronous induction motors) if connected to earth or disconnected from the field windings during starting	As for the windings to which they are connected twice rated exciter voltage + 1000, with a minimum of 1500
	b) Exception 2 Separately excited field windings of exciters	as under item 3

2.2.6 Overspeed test

As proof of mechanical strength, a two minute overspeed test is to be carried out as follows:

a) for generators with their own drive, at 1,2 times the rated speed

b) for constant-speed motors, at 1,2 times the no-load speed

c) for variable-speed motors, at 1,2 times the maximum no-load speed

d) for motors with series characteristics, at 1,2 times the maximum speed shown on the name plate, but at least at 1,5 times the rated speed.

The overspeed test may be dispensed with in the case of squirrelcage induction motors.

2.2.7 Measurement of insulation resistance

Measurement of insulation resistance is to be performed, wherever possible, on the machine at service temperature at the end of the test schedule. The test is to be carried out using a DC voltage of at least 500 V. The minimum insulation resistance shall be not less than 1 Megaohm.

2.3 Testing in the presence of a Surveyor

2.3.1 All electrical machines are to be tested at the manufacturer's works. When test procedure is not specified, requirements of IEC 60034 apply.

2.3.2 All generators and electrical motors with an output of 50 kVA or 50 kW and over are to be of type approved and tested at the manufacturer's works in the presence of a Surveyor.

The Society reserves the right to stipulate that a works test be performed on new types of machines which are to be installed for the first time on a unit with class or where there are special grounds for specifying such a test.

Individual tests may be replaced by type tests.

SECTION 4 TRANSFORMERS AND REACTORS

1 General

1.1 General requirements

1.1.1 Transformers are to be installed in well ventilated locations or spaces. Transformers with exposed live parts are to be installed in special spaces accessible only to the responsible personnel. The installation of liquid-cooled transformers requires the Society's special approval.

1.1.2 As a general principle, the primary and secondary windings of transformers are to be separated electrically. For the adjustment of the secondary voltage, taps are to be provided corresponding to ± 2,5% of the rated voltage.

Starting transformers are excepted from this rule.

1.1.3 Power transformers have to be tested according to IEC 60076.

Transformers with a power rating of 50 kVA or more are to undergo a test at the manufacturer's works in the presence of a Surveyor.

Individual tests may be replaced by One's Own Responsibility Test made by the manufacturer.

1.1.4 The manufacturer is to fit to transformers/reactors a name and date plate containing the serial number of the unit and all essential operating data.

SECTION 5 STORAGE BATTERIES

1 General

1.1 Application

1.1.1 These regulations apply to permanently installed storage batteries.

1.1.2 Only storage batteries suitable for floating units use can be used.

2 Design and construction of cells

2.1 General

2.1.1 Cells shall be so designed that they retain their normal operation at inclination of up to 15° and no electrolyte leaks out at inclination of up to 40°. Cells should be combined in cabinets, containers or racks if the weight of single cells allows this.

The weight of a battery or battery element shall not exceed 100 kg.

3 Data plate and operation instructions

3.1 General requirements

3.1.1 Each battery or battery element shall be marked with maker's name and type of battery, containing all relevant data for operation.

3.1.2 For each type of battery an operation manual shall be delivered. It shall contain all informations for proper maintenance and operation.

4 Installation and location

4.1 General requirements

4.1.1 Storage batteries are to be installed in such a way that they are accessible for cell replacement, inspection, testing, topping-up and cleaning.

The installation of batteries in the accommodation area and in control stations is not permissible. Gastight batteries can be seen as an exception, e.g. in case of internal power source of emergency lighting fittings.

4.1.2 Storage batteries are not to be installed in locations where they are exposed to unacceptably high or low temperatures, spray or other effects liable to impair their serviceability or reduce their life essentially. They are to be installed in such a way, that adjacent equipment is not damaged by the effects of escaping electrolyte vapours.

4.1.3 Lead-acid batteries and alkaline storage batteries are not to be installed in the same room or in the immediate vicinity of each other.

4.1.4 Measures are to be taken to prevent storage batteries from shifting. The braces used shall not impede ventilation.

4.1.5 For the installation of storage batteries the total power of associated charger has to be considered.

The charging power is to be calculated from the maximum current of the battery charger and the rated voltage of the battery.

For automatic IU-charging, the charging power may be calculated as stated under [6.3].

5 Battery room equipment

5.1 General requirements

5.1.1 Only explosion protected lamps, switches, fan motors and space heating appliances shall be installed in Battery Rooms. The following minimum requirements shall be observed:

- Explosion group II C
- Temperature class T 1.

Other electrical equipment is permitted only with the special approval of the Society.

5.1.2 Where leakage is possible, the inner walls of Battery rooms, cabinets and containers shall be protected against the injurious effects of the electrolyte.

6 Ventilation

6.1 General requirements

6.1.1 All battery installations in rooms, cabinets and containers shall be constructed and ventilated in such a way as to prevent the accumulation of ignitable gas mixtures.

Gastight NiCd-, NiMH- or Li- batteries may not be ventilated.

6.2 Batteries installed in switchboards charging power up to 0,2 kW

6.2.1 Lead batteries with charging power up to 0,2 kW may be installed without separation to the switchgear, if:

a) the batteries are of valve regulated type (VRL), provided with solid electrolyte and

b) the switchboards are not closed completely (IP 2X will be suitable) and

c) the charger is an automatic IU-charger with a maximum continuous charging voltage of 2,3 V/cell and rated power is limited on 0,2 kW.

6.3 Ventilated spaces, battery charging power up to 2 kW

6.3.1 Batteries with charging power up to 2 kW may be installed in ventilated cabinets or containers arranged itself in ventilated rooms (except in rooms according to [4.1.1] and [4.1.2]). The unenclosed installation (IP 12) in well ventilated positions in machinery spaces is permitted. The charging power for automatic IU-charging should be calculated as follows:

$P = U.I$

$I = 8 \times C/100$ for Pb - batteries

$I = 16 \times C/100$ for NiCd - batteries

where:

P	:	Charging power, in W
U	:	Rated battery voltage, in V
I	:	Charging current, in A
C	:	Rated battery capacity, in Ah.

Battery's gassing voltage shall not be exceeded. If several battery sets are be used, the sum of charging power has to be calculated.

The room free air volume should be calculated depending on battery size as follows:

$V = 2,5 \times Q$

where:

V	:	Free air volume, in m^3
Q	:	Air quantity, in m^3/h
		$Q = 0,25 \times f \times I \times n$
n	:	number of battery- cells in series connection
f	:	f = 0,03 for lead batteries (VRL) with solid electrolyte
		f = 0,11 for batteries with fluid electrolyte.

If several battery sets will be installed in one room, the sum of air quantity shall be calculated.

The air ducts for natural ventilation shall have a cross-section as follows, assuming an air speed of 0,5 m/s:

$A = 5,6 \times Q$

where:

A	:	Cross section, in cm^2

The required minimum cross-sections of ventilation ducts are shown in Tab 1.

Small air ducts and dimensions of air inlet and outlet openings should be calculated based on lower air speed (≤ 0,5m/s).

6.4 Ventilated rooms, battery charging power more than 2 kW

6.4.1 If the charging power of batteries exceeds 2 kW, it has to be installed either in closed cabinets, containers or a Battery room to be ventilated to the open deck. Lead batteries up to 3 kW still may be ventilated by natural ventilation.

Battery rooms are to exhaust to open deck area. It should be used forced ventilation.

Doors to battery rooms have to be gastight with self-closing devices without holding back means.

6.5 Ventilation requirements

6.5.1 Ventilation inlet and outlet openings shall be so arranged to ensure that fresh air flows over the surface of the storage battery.

The air inlet openings shall be arranged below and air outlet openings shall be arranged above.

If batteries are installed in several floors, the free distance between them shall be at least 50 mm.

Devices which obstruct the free passage of air, e.g. fire dampers and safety screens, shall not be mounted in the ventilation inlet and outlet ducts. If necessary, weathertight closures shall be carried out otherwise.

Air ducts for natural ventilation shall lead to the open deck directly. Openings shall be at least 0,9 m above the cabinet/container. The inclination of air ducts shall not exceed 45° from vertical.

6.6 Forced ventilation

6.6.1 If natural ventilation is not sufficient or required cross-sections of ducts according to Tab 1 are too big, forced ventilation shall be provided. The air quantity Q shall be calculated according to [6.3]. The air speed shall not exceed 4 m/s.

Where storage batteries are charged automatically, with automatic start of the fan at the beginning of the charging, arrangements shall be made for the ventilation to continue for at least 1 h after completion of charging.

Wherever possible, forced ventilation exhaust fans shall be used. The fan motors shall be either explosion-proof and resistant to electrolyte or, preferably, located outside of the endangered area.

The fan impellers shall be made of a material which does not create sparks on contact with the housing, and dissipates static charges.

The ventilation systems shall be independent of the ventilation systems serving other rooms.

Air ducts for forced ventilation shall be resistant to electrolyte and shall lead to the open deck.

Table 1 : Cross-sections of ventilation ducts

Calculation based on battery charging power (automatic IU- charging)			
Battery charging power	Cross-section, in cm²		
[W]	Lead battery solid electrolyte VRL	Lead battery fluid electrolyte	Nickel-Cadmium battery
< 500	40	60	80
500 < 1000	60	80	120
1000 < 1500	80	120	180
1500 < 2000	80	160	240
2000 < 3000	80	240	forced ventilation
> 3000	forced ventilation		

7 Warning signs

7.1 General

7.1.1 At doors or openings of battery rooms, cabinets or containers warning notices have to be mounted drawing attention to the explosion hazard in those areas and that smoking and handling of open flames are prohibited.

8 Starter batteries

8.1 General requirements

8.1.1 Storage batteries for starting internal combustion engines shall be designed to have sufficient capacity for at least six starting operations in 30 minutes without intermediate recharging.

8.1.2 Starter batteries may only be used to start engines and supply energy to the monitoring systems allocated to them.

8.1.3 Starting internal combustion engines with the unit's supply battery is permitted only in emergencies.

8.1.4 Wherever possible storage batteries used for starting and preheating internal combustion engines are to be located close to the machines.

9 Rating of storage battery chargers

9.1 General requirements

9.1.1 The following requirements apply to units assigned the additional service feature **Autonomous**.

9.1.2 Charging equipment shall be so rated that discharged storage batteries can be charged to 80% of their rated capacity within a period not greater than 15 hours without exceeding the maximum permissible charging currents.

Only automatic chargers shall be used with charging characteristic adapted to the type of batteries.

9.1.3 If consumers are simultaneously supplied during charging, the maximum charging voltage shall not exceed 120% of the rated voltage. The power demand of the consumers shall be considered for the selection of the chargers.

Battery charger's with rating power of 2 kW upwards have to be tested in manufacturer's work in the presence of Society's Surveyor.

SECTION 6 POWER DISTRIBUTION

1 Subdivision of the distribution network

1.1 General

1.1.1 Consumers are to be arranged in sections or consumer groups. The following main groups are to be supplied separately:

- Lighting circuits
- Power plants
- Heating plants
- Signal, communication, command and alarm system.

2 Hull return

2.1 General

2.1.1 In systems using hull return, the final subcircuits for space heating and lighting are to be insulated on all poles. The earth for the hull return connection is to be formed by connecting the earth busbar in the main or subsidiary distribution board to the unit's hull. The earth connection shall be located in an easily accessible position so that it can easily be tested and disconnected for the purpose of testing the insulation of the circuit. Earth connections shall be at least equal in cross-section of the supply leads. Bare leads may not be used. Casings and their retaining bolts may not be used for the earth return or for connecting the return lead to the unit's hull. The connecting surface of the cable lug shall be metallically clean. The cable lug is to be tinned. The terminal screws are to be made of brass and are to be compatible with the cable cross-sections. The smallest permissible size is M 6.

3 Final subcircuits

3.1 General

3.1.1 Final lighting subcircuits and plug socket circuits within the accommodation are to be fitted with fuses rated for not more than 16 A. The load on each lighting subcircuit shall not exceed 10 A.

The number of lighting points supplied by a final sub-circuit shall not exceed the numbers given in Tab 1.

Table 1 : Maximum number of lighting points

Voltage	Maximum number of lighting points
Up to 55 V	10
from 56 V to 120 V	14
from 121 V to 250 V	24

3.1.2 Plug sockets (outlets) are to be connected to separate circuits wherever possible.

Final subcircuits for lighting in accommodation spaces may, as far as practicable, include socket outlets.

In that case, each socket outlet counts for 2 lighting points.

3.1.3 In machinery spaces and other important service spaces and control stations, the lighting shall be supplied by at least two different circuits.

The lamps are to be so arranged that adequate lighting is maintained even if one of the circuits fails.

4 Signal lamps

4.1 General

4.1.1 The switchboard for signal lamps shall be mounted in the control station and shall be supplied by a separate cable from the main switchboard, if no change-over to a separate feeder is provided.

4.1.2 A number of locally grouped signal lamps may be jointly supplied, controlled and monitored provided that the monitoring system indicates or signals the failure of even one such lamp.

4.1.3 Signal lamps shall be designed for the standard voltages: 24 V, 110 V or 220 V.

5 Shore connection

5.1 General

5.1.1 Shore line terminal containers are to be connected to the main switchboard by a permanently laid cable.

5.1.2 Consequences of mooring breaks on the shore connection are to be considered. It shall not lead to critical damages on the installation.

5.2 Connection equipment

5.2.1 The shore connection is to be protected at the main switchboard by a switch or contactor with control switch and fuses or a power circuit breaker with overload protection. Switch, contactor or power circuit breaker are to be interlocked with the generator circuit in such a way as to prevent the unit's generator operating in parallel with the shore mains.

5.2.2 When using plug-type shore connectors with a current rating of more than 16 A, an interlocking device with switch is to be fitted so that the connection on board can only be made in the dead condition. Short-circuit protection at the connection can then be dispensed with.

In order to prevent contact with live parts, plug-type shore connectors are to be designed as appliance connectors comprising a coupler plug mounted on board and a coupler socket supplied from the shore.

With a connecting voltage of more than 50 V a provision is to be made for connecting the unit's hull to earth. The connection point shall be marked.

On units with DC-power system with hull return the negative pole of the shore side power source shall be connected to the unit's hull.

5.2.3 The main switchboard is to be equipped with an indicator showing whether the shore connection cable is live.

5.2.4 Instruments shall be available for comparing the polarity of a DC power supply or the phase sequence of a 3-phase power supply from the shore with that of the unit's network. The installation of a phase change overswitch is recommended.

5.2.5 The following details are to be given on a data plate in the shore line terminal box:

- Kind of current, rated voltage and frequency for alternating current
- The concerning measures are to be taken for the shore connection.

5.2.6 To reduce the load on the terminals, the shore line is to be provided with a tension relief device.

5.2.7 Only flexible, oil-resistant and flame retardant cables are to be used as feeder cables.

6 Power supply to other units

6.1 General

6.1.1 A separate junction box is to be provided in the case of supplying power to other units. The branch is to be fitted with fuses and an on-load switch or with a power circuit breaker with overcurrent and short-circuit protection. Where voltages of more than 50V and/or currents of more than 16A are transmitted, it is necessary to ensure that the connection can only be made in the dead condition. Where a connecting line carrying a voltage of more than 50 V is wrenched out of its connector, it shall immediately be deenergized by a forcing circuit. The same applies to a rupture of the connecting cable.

Unit hulls have to be conductively connected.

Facilities have to be provided to allow this.

Connecting cable suspensions shall be tension-relieved.

SECTION 7 SWITCHGEAR INSTALLATIONS AND SWITCHGEAR

1 Switchboards

1.1 General rules

1.1.1 Switchboards shall contain all the gear, switches, fuses and instruments necessary for operating and protecting the generators and main power distribution systems. They shall be clearly, easily and safely accessible for the purposes of maintenance, repair or renewal.

1.1.2 Built-in gear, instruments and operating equipment are to be indelibly marked. The current ratings of fuses and the response values of protective devices are to be indicated.

1.1.3 The replacement of fuse elements shall be possible without removing panels or covers. Different voltages and types of current are to be clearly indicated.

1.1.4 Where switchgear or fuses carrying a voltage of more than 50 V are located behind doors, the live parts of appliances mounted on the door (switches, pilot lights, instruments) shall be protected against being touched by accident (see Ch 2, Sec 1, [4.4]).

1.1.5 Busbars and bare connections shall be made of copper. Even under adverse operating conditions, their temperature rise may not exceed 40°C. Busbars are to be fastened and secured in such a way that they are able to withstand the mechanical stresses produced by the greatest possible short-circuit currents.

1.1.6 All screwed joints and connections are to be secured against spontaneous loosening. Screws up to M 4 size may be secured with lacquer or enamel.

1.1.7 With the exception of the connections between switchgear and outgoing terminals, switchboards may only contain lines with cross-sections of up to 50 mm². If larger cross-sections are required, a main busbar system is to be provided for connecting generators and consumers.

1.1.8 The power feed for the control of consumers is to be picked up on the consumer side downstream of the main fuses. Exceptions will be permitted only in special cases.

1.1.9 Where fuses and switches are used, the sequence shall be busbar - fuse - switch.

1.1.10 Neutral conductors in 3-phase systems shall have at least half the cross-section of the outer conductors. For line cross-sections of up to 16 mm², neutral conductors shall have the full cross-section of the outer conductors. Equalizer lines for 3-phase alternator exciters shall be designed to carry half the exciting current of the largest alternator and shall be laid separately from other lines.

1.1.11 The smallest permissible cross-section for wiring inside the switchboard, including measuring wires and control lines, is generally 0,5 mm². Smaller cross-sections are allowed only in automation and telecommunication equipment and for data bus/data cables. Lines without fuse protection from the main busbar to fuses and protective switches shall be as short as possible not longer than 1 m. They may not be laid and fastened together with other lines.

Shunt circuits within the switchboard shall be laid separately from other lines and shall generally not be protected by fuses.

Important control lines shall be laid and protected in such a way they cannot be damaged by arcing due to switching operations or, as far as possible, short-circuits.

1.1.12 It shall be possible to observe meters and indicators and to operate the switchgear from the front of the switchboard with the doors closed.

1.1.13 Operating handles shall generally not be located less than 300 mm above floor level. The operating handles of generator switches are to be located at a distance of at least 800 mm from the floor.

1.2 Installation of switchboards

1.2.1 Switchboards are to be installed in easily accessible and adequately ventilated spaces in which no flammable gases can gather. They are to be protected against water and mechanical damage.

Switchboards on the floorplates over the bilges shall be closed from below.

Pipes and air trunks are to be so arranged that any leakage does not endanger the switchgear. Where the routing of pipes and trunks close to switchboards cannot be avoided, they are to have no flanged or screwed joints in this section.

Cabinets and recesses for housing switchboards shall be made of non-combustible material (see Ch 3, Sec 1, [2.6.2] for definition) or shall be protected by a metal or other fireproof lining. The doors of cabinets and recesses are to bear a notice drawing attention to the switchboard installed therein. A service passageway at least 0,6 m wide is to be provided in front of switchboards.

1.2.2 A service passageway of not less than 0,5 m behind the switchboard is called for only when required by its construction or maintenance.

1.2.3 In the case of voltages over 50 V, insulating gratings or mats shall be placed behind the switchboards and in front of their control sides. No live parts may be mounted on the front side of switchboards.

Parts located to the rear of an open switchboard and carrying voltages of more than 50 V shall be protected against contact up to a height of 0,3 m.

1.3 Distribution boards

1.3.1 The Rules set out in [1.1] apply in analogous manner.

1.3.2 Where a number of distribution boards are supplied via a common feeder cable without intermediate protection, the busbars and the connecting terminals shall be dimensioned to withstand the total load.

1.3.3 Distribution circuits shall be protected in accordance with [3.1] and [3.9] against damage due to short-circuit and overload. Final subcircuits with fuses rated at more than 63 A shall be fitted with on-load switches. On-load switches may be dispensed with in final subcircuits with fuses rated up to 63A provided that each connected consumer can be disconnected by a switch located nearby.

1.3.4 Distribution boards for the supply of mobile consumers, e.g. container plug sockets shall be individually supplied from the distribution board and shall be individually fused and individually disconnectable.

A pilot light or voltmeter is to be provided to show whether the distribution board is live.

1.3.5 Motor switchgear shall be accessible for the purposes of inspection and repair without the need to disconnect other important circuits.

Mechanical devices, ammeters or indicator lights shall show whether the motor is switched on.

Motor switchgear units or their control switches are normally to be located close to their respective motors. Where for operational reasons they are placed out of sight of the motor, personnel working on the motor shall be provided with means of protecting themselves against the unauthorized switching on of the motor.

Motors shall be disconnected on all poles as a matter of principle.

1.4 Switchboard testing

1.4.1 Before being installed on board, every switchboard together with all its equipment is to be subjected to the following test ([1.4.2] to [1.4.5]).

1.4.2 A test at the manufacturer's works in the presence of a Society Surveyor is to be carried out on main switchboards for a connected generator output of more than 100 kW/ kVA, and on all switchboards for emergency generator sets. The Society reserves the right to call for a works test on other switchboards where there are special reasons for this.

1.4.3 Operational test

As far as possible, the proper operation of the equipment is to be checked in accordance with the design.

1.4.4 High-voltage test

High-voltage test is to be performed for a period of one minute at the test voltage shown in Tab 1.

Measuring instruments and other ancillary equipment may be disconnected during the test.

Table 1 : Test voltages for main circuits

Rated insulation voltage Ui, in V	Test voltage A.C. (r.m.s), in V
$Ui \leq 60$	1000
$60 < Ui \leq 300$	2000
$300 < Ui \leq 690$	2500

1.4.5 Insulation resistance measurement

Insulation resistance measurement is to be performed using at least 500 V DC. For the purpose of this test, large switchboards may be divided into a number of test sections. The insulation resistance of each section shall be at least 1 Megohm.

2 Switchgear

2.1 General

2.1.1 As a general principle, switchgear shall be type approved, designed and constructed in accordance with standard IEC, EN or to other standards recognized by the Society.

2.2 Selection of switchgear

2.2.1 Switchgear is to be selected not merely by reference to its rated current but also on the basis of its thermal and dynamic strength and its making and breaking capacity.

On-load breakers shall be designed to carry at least the rated current of the series-connected fuse.

Circuit breakers shall act on all live conductors simultaneously. It shall be clearly apparent whether the breaker is in the open or closed position.

Installation switches in lighting systems up to 16A are exempted from this rule.

2.3 Power circuit breaker

2.3.1 Power circuit breakers are to be provided with trip-free release. Their rated making and breaking capacity shall be sufficient to make or break short-circuit currents at the installation site.

2.4 Fuses

2.4.1 The fuse elements or cartridges shall have an enclosed fusion space. They shall be made of a ceramic material or a material recognized by the Society as equivalent. The fuse element shall be embedded in a heat-absorbing material.

2.4.2 It shall be possible to replace the fuse elements or cartridges without exposing the attendant to the danger of touching live components or suffering burns. Where grip-type fuses are used, a detachable grip is permissible.

3 Switchgear, protective and monitoring equipment

3.1 General

3.1.1 Generators, power consumers and circuits shall be protected in each one of their non-earthed poles or conductors against damage due to overload or short-circuit. In insulated DC and single-phase AC circuits and in insulated 3-phase circuits with balanced load, the overload protection may be dispensed with in one conductor.

3.1.2 The protective devices are to be coordinated in such a way that, in the event of a fault, only the defective circuit is disconnected and the supply to the sound circuits is maintained.

3.1.3 All non-earthed poles shall be connected and disconnected simultaneously. In earthed systems, lines are to contain neither switches nor fuses in their earthed pole or conductor.

3.2 Equipment for 3-phase AC generators

3.2.1 Switchgear and protective devices for individual operation 3-phase AC generators are to be provided with 3-pole power circuit breakers with delayed-action overcurrent trip and short-delayed short-circuit trip to obtain selectivity. This protective equipment is to be designed as follows:

a) The overload trip, which is to be set at an overcurrent of between 10% and 50%, shall open the power circuit breaker with a maximum time delay of two minutes.

   A setting of more than 50% overcurrent may be approved if required by the operating conditions and compatible with the generator or primemover design.

b) The short-circuit trip is to be set at an overcurrent of more than 50% but less than the sustained short-circuit current. It shall operate with a short delay of up to about 500 ms adjusted to suit the selectivity of the system.

c) On generators rated at less than 50 kVA, fuses and contactors or on-load switches may be used provided that the requirements of a) and b) are satisfied in an analogous manner. For this purpose the contactors shall also have a delayed drop-out.

   The contactors are to be designed for at least twice the rated generator current.

3.2.2 Switchgear and protective devices for parallel operation

The following equipment is to be provided in addition to the switchgear and protective devices specified above [3.2.1].

a) 3-phase AC generators rated at 50 kVA and above shall be provided with reverse-power protection with a time delay of 2 to 5 seconds.

   The protective device shall be selected and adjusted to suit the characteristics of the prime mover. Reference values for the setting are 4% to 10% of the rated current for diesel-driven generators. The protection should, wherever possible, be set to 50% of the prime mover trailing power. A voltage drop to 60% of the rated voltage shall not render the reverse-power protection ineffective within the specified range.

b) The generator switches shall be fitted with undervoltage protection which prevents the contact assemblies from closing when the generator is deenergized. If the voltage drops to between 70% and 35% of the rated voltage, the generator switch shall open automatically. Undervoltage trips shall have a short time delay matched to the short-circuit trip called for in [3.2.1]b).

c) A synchronizing device is to be fitted. Where automatic synchronizing equipment is fitted, provision shall also be made for manual independent synchronization.

d) In the case of parallel operating generators with individual output rating of more than 50 kVA, protection is to be provided against the effects of paralleling the generators when in phase opposition.

   For example, the following may be used for this purpose:

   - a reactor which limits to a permissible degree the electrical and mechanical stresses arising from faulty synchronization. It is to be disconnected when the generator switch is closed or
   - a synchronizing interlock which allows the generator switch to cut in only up to an angular deviation of 45° (electrical) maximum, and also blocks the connection in case of too large a difference frequency. The permissible difference frequency depends on the characteristics of the generator switch and its drive and shall not generally exceed 1 Hz.

3.3 Equipment for DC generators

3.3.1 Switchgear and protective devices for individual operation

a) DC generators are generally to be provided with power circuit breakers with delayed-action overcurrent trip and short-delayed short-circuit trip to obtain selectivity. The switchgear and protective devices are to conform to [3.2.1] (for individual operation) with the difference that the short-circuit trip is to have a short time delay of up to about 200 ms.

b) A polarity-reversing facility, if necessary.

3.3.2 Switchgear and protective devices for parallel operation

The following equipment is to be provided in addition to the switchgear and protective devices specified in [3.3.1]:

a) DC generators equipped for parallel operation with each other or with a storage battery shall be fitted with reverse-current protection with no-delay action or with a short delay of up to 1 second.

The protective device shall be selected and adjusted to suit the characteristics of the prime mover. Reference values for the setting are 4% to 10% of the rated output for diesel-driven generators.

b) Undervoltage protection as described in [3.2.2] b) for parallel operation.

c) In the case of compound-wound generators, the power circuit breaker shall be provided with an equalizer circuit contact assembly which, on making, closes simultaneously with, or in advance of, the contacts of the power circuit breaker and, on breaking, opens simultaneously with, or after, the contacts of the power circuit breaker, and is designed to carry at least half the rated current.

3.4 Special rules

3.4.1 On-load switches, power circuit breakers and, generally speaking, reverse-current cutouts can be dispensed with in the case of generators with outputs of up to 10 kW (kVA) and a voltage of 50 V or less which, because of their control equipment, do not need to be subjected to switching operations in service. Further exemptions may be allowed depending on the design of the equipment.

3.5 Disconnection of non-essential consumers

3.5.1 It is recommended that a device be installed which, when the generator reaches its rated output, emits a warning signal after about 5 s and automatically cuts off consumers whose temporary disconnection will not jeopardize the safety of the unit and its machinery installation. The disconnection of the loads may be effected in one or more steps. The automatic disconnection of non-essential consumers is mandatory on larger units and on units with automated engine operation.

3.6 Measuring and monitoring equipment

3.6.1 The measuring error of switchboard instruments may not exceed 1,5% of the scale terminal value. Directionally sensitive instruments are to be used for DC generators and storage batteries.

The scale of voltmeters shall cover at least 120% of the rated voltage, that of ammeters at least 130% of the maximum amperage to be expected in continuous operation. Ammeters are to be designed to avoid damage due to motor starting currents.

The scale of watt meters shall cover at least 120% of the rated power. For generators operating in parallel, the scale shall also cover at least 12% of the reverse power. In the case of power meters with only one current path, the measurement shall be performed in the same phase on all generators. Where the total power input to all consumers connected to one phase reaches more than 10% of the output of the smallest alternator, the power meters shall be equipped with multiple movements to register also the unbalanced load on the outer conductors.

Frequency meters are to be capable of registering deviations of down to ± 5 Hz from the rated frequency. Vibrating reed instruments with 21 reeds are recommended.

The main switchboard (main distribution board) is to be provided with ammeters for major consumers, unless these are mounted at the consumers themselves. One instrument may be used for more than one circuit. The rated currents are to be marked on the instrument scales, or on a separate panel in the case of multi-circuit instruments with change-over switch. The rated service values are to be marked in red on the scales of all instruments.

3.6.2 Generator measuring and monitoring equipment

a) Each DC generator is to be provided with:
   - 1 voltmeter
   - 1 ammeter
   - 1 blue pilot light (generator live)
   - Where circuit breakers are used, the following additional lights are to be provided:
   - 1 green pilot light (circuit breaker closed)
   - 1 red pilot light (circuit breaker open)

b) Battery
   - 1 centre zero ammeter

c) Bus-bar
   - 1 voltmeter

d) Each 3-phase AC generator is to be provided with:
   - 1 voltmeter, where necessary capable of switching to the other generators
   - 1 ammeter, connectable to each phase conductor
   - 1 wattmeter (active power meter) for generators with outputs of 50 kVA and over
   - 1 frequency meter, where necessary capable of switching to the other generators
   - Pilot lights as specified for DC generator here above.

3.6.3 Special rules

Instead of the ammeter and the blue pilot light specified in b), a charging pilot light may be provided for installations with an output of up to 10 kW/ kVA and a voltage of ≤ 50 V.

3.6.4 Protection of generator monitoring and control circuits

The following circuits are to be supplied by the generator direct and are to be individually fused (using fusible cutouts):

- Generator protective relay and generator switch undervoltage trip
- Measuring instruments
- Synchronizing equipment
- Pilot lights
- Speed adjuster
- Electrical generator switch drive
- Automatic power supply system (measuring voltage).

3.6.5 Earth fault indication

Every non-earthed primary or secondary system is to be equipped with devices for checking the insulation resistance against unit's hull.

Where filament lamps are used as indicators, their power input may not exceed 15 W. The lamps may be earthed only during testing by means of a pushbutton switch.

An insulation monitoring system may be dispensed with in the case of secondary circuits such as control circuits.

3.6.6 Insulation monitoring equipment

Where insulation monitoring devices are used, they shall provide a continuous indication of the insulation resistance and shall trip an alarm if the insulation resistance of the network drops below 100 ohms per volt of the network voltage.

With a full earth fault the measuring current may not exceed 30 mA.

3.7 Transformer protection

3.7.1 The windings of transformers shall be protected against short circuit and overload by multi-pole power circuit breakers or by fuses and on-load switches in accordance with the above Rules. Transformers for parallel operation shall be fitted with isolating switches on the secondary side.

Overload protection primary side may be dispensed with where it is protected on the secondary side.

3.8 Motor protection

3.8.1 Motors rated at more than 1 kW shall be individually protected against overloads and short circuits.

It is permissible to provide common short-circuit protection for a motor and its own individual supply cable.

The protective devices shall be suited to the particular operating modes of the motors concerned and shall provide reliable thermal protection in the event of overloads.

If the current-time characteristic of the overload protection is not compatible with the starting characteristics of a motor, the overload protection may be disabled during start-up. The short-circuit protection shall remain operative.

The switchgear of motors whose simultaneous restarting on restoration of the voltage after a power failure might endanger the operation of the installation shall be fitted with a facility which:

- interrupts the circuit in response to a voltage drop or power failure and prevents automatic restarting, or
- causes the motor to start up again automatically without any inadmissible starting current on restoration of the voltage. Where necessary, the automatic restarting of a number of motors is to be staggered in time.

The undervoltage protection shall work reliable between 70% and 35% of the rated voltage.

3.9 Circuit protection

3.9.1 Every distribution circuit shall be protected against damage due to overloads and short circuits by means of multi-pole power circuit breakers or fuses in accordance with the above Rules. Final subcircuits supplying power to a consumer fitted with its own overload protection may be provided with only short-circuit protection at the feed point. Under continuous service conditions fuses for this purpose may be two stages higher than for the rated service of the consumer in question; for short-period and intermittent service, the rated current of the fuse may not be greater than 160% of the rated consumer current. The corresponding switches are to be designed for the rated amperage of the fuse.

Automatic cutouts and protective motor switches shall, where necessary, be backed up by the series-connected fuses specified by the manufacturer. In the case of important consumers, automatic cutouts without selectively staggered disconnecting delay may not be arranged in series.

3.10 Storage battery protection

3.10.1 Batteries, except starter batteries, shall be provided with short-circuit protection situated near the batteries, but not in battery's cabinet or container. Emergency batteries supplying essential services may only be provided with short- circuit protection sufficient for their cables. The value of the fuses may be two stages higher than the corresponding values for the rated cable current shown in Ch 2, Sec 11, Tab 3 and Ch 2, Sec 11, Tab 4, column 3, or of power circuit breakers with suitably adjusted short-circuit protection.

3.11 Protection of measuring instruments, pilot lights and control circuits

3.11.1 Indicators, measuring instruments and pilot lights are to be protected by fuses. Pilot lights with operating voltage over 24 V are to be fused separately from control circuits in every case so that a short circuit in the lamp does not cause failure of the control circuits. Pilot lights connected via short-circuit-proof transformers may be fused jointly with control circuits.

3.12 Exciter circuits

3.12.1 Exciter circuits and similar circuits whose failure might endanger the operation of essential systems may not be protected, or may be protected only against short circuits.

3.13 Emergency disconnecting switches

3.13.1 Fuel pumps, machinery space and ventilators shall be provided with an individual emergency disconnecting switch located at a central position outside the machinery space unless other means are available for rapidly interrupting the fuel and air supply outside the room in which the equipment is installed.

4 Control and starting equipment

4.1 Operating direction of handwheels and levers

4.1.1 Handwheels and levers of starters and drum controllers not intended for reversing are to be arranged to turn clockwise for starting the motors. Motor speed and generator voltage control is to be so effected that clockwise rotation increases the speed/voltage. The linear movement of handles upwards or to the right shall produce the same effect as clockwise rotation.

4.2 Hand-operated controllers, resistors

4.2.1 The temperatures of handles and other parts which have to be touched in order to operate equipment may not exceed the following values in service:

- Metal parts 50°C
- Insulating material 60°C

Resistor casings whose temperature is liable to exceed 60°C are to be so mounted that they cannot be touched by accident.

The temperature rise of the air flowing from the casing may not exceed 165°C in the case of resistors integral to starters and controllers or 190°C for separately mounted resistors.

SECTION 8 ELECTRIC HEATING APPLIANCES

1 General

1.1

1.1.1 The use of portable, unsecured heating and cooking appliances is not permitted except for appliances which are under constant supervision when in use, e.g. soldering irons, flat irons and appliances where special precautions are taken to prevent the build-up of heat to ignition temperature (e.g. electric cushions and blankets).

1.1.2 The installation and use of electric heaters is not allowed in spaces where easily flammable gases or vapours may accumulate or in which ignitable dust may be deposited.

2 Space heaters

2.1 Arrangement of heaters

2.1.1 No hooks or other devices on which clothing can be hung may be fitted above heaters without temperature limitation.

2.1.2 Where heaters are fitted in the bulkhead lining, a trough made of non-combustible material (see Ch 3, Sec 1, [2.6.2] for definition) shall be mounted behind each heater in such a way as to prevent the accumulation of heat behind the lining.

2.1.3 Only waterproof heaters according to IEC 60335 may be used in washrooms, bathrooms and other damp spaces as well as in machinery spaces.

2.2 Enclosures

2.2.1 Heater enclosures are to be so designed that no objects can be deposited on them and air can circulate freely round the heating elements.

2.3 Thermal design of heaters

2.3.1 Electrical space heaters are to be so designed that, at an ambient temperature of 20°C, the temperature of the outer jacket or cover and the temperature of the air flowing from the heater do not exceed 95°C.

For the maximum permissible temperature of control components and their immediate vicinity, see [3.2.1].

2.4 Electrical equipment of heaters

2.4.1 Only heating elements with sheathed or ceramic-encased coils may be used.

To prevent the build-up of heat leading to excessive temperature rises, every heater is to be equipped with thermal protection which interrupts the current as soon as the maximum permissible heater temperature is exceeded. Automatic restarting shall be prevented.

2.4.2 Self regulating material in heating elements may be dispensed with.

2.4.3 The operating switches shall disconnect all live conductors when in the off position. The off position and the positions for the various operating levels shall be clearly marked on the switches.

2.4.4 Every space heater shall normally be connected to a separate circuit. However, a number of small space heaters may be connected to a common circuit provided that their total current input does not exceed 16 A.

3 Electric ranges and cooking equipment

3.1 Cooking plates

3.1.1 Only enclosed-type cooking plates may be used.

3.2 Switches

3.2.1 The switches of the individual cooking plates shall disconnect all live conductors when in the off position. The switch steps shall be clearly marked.

Switches and other control elements shall be so fitted that they are not exposed to radiant heat from the cooking plates or heating elements. The maximum permissible temperature limits specified in [3.2.1] are applicable.

SECTION 9 LIGHTING INSTALLATIONS

1 General

1.1

1.1.1 Lighting installations are to be designed in compliance with the paragraphs listed below:

- Ch 2, Sec 1, [5.2], Voltages and frequencies
- Ch 2, Sec 6, [3.1], Final subcircuits
- Ch 2, Sec 6, [4.1], signal lights
- Ch 2, Sec 1, [4.4.2], Ch 2, Sec 1, [4.4.3] and Ch 2, Sec 1, [4.4.4] to Ch 2, Sec 1, [4.4.12], Explosion proofing.

2 Design of lighting installations

2.1

2.1.1 The number of lamps and their distribution shall be such as to ensure satisfactory illumination.

2.1.2 In machinery and service spaces, service passageways and commissary spaces, lighting fixtures are to be provided which are sufficiently robust for this application. The lighting fixtures shall be fitted with impact resistant covers.

2.1.3 Wherever possible, separate circuits are to be provided for plug sockets.

2.1.4 The use of normal shore type light fittings is permitted in accommodation, day rooms and commissary spaces provided that they comply with the Rules contained in [3].

3 Design of lighting fixtures

3.1

3.1.1 Lighting fixtures shall have a base which reflects and dissipates the heat produced by the light source. The mountings used shall provide a gap of at least 5 mm to allow cooling air to circulate between the base of the fixture and a combustible surface to which it is fastened.

Lighting likely to be exposed to more than ordinary risk of mechanical damage shall be protected against such damage or to be of a special robust construction.

3.1.2 The temperature of lighting fixtures should not exceed 60°C where they can be touched easily.

3.1.3 Heat-resistant leads are to be used for the internal wiring of lamp-holders.

3.1.4 Metal lighting fixtures shall be fitted with an earthing screw in the casing or base. All metal parts inside a lighting fixture are to be conductively connected to each other.

The connecting terminals shall be directly fastened to the lighting fixture.

3.1.5 Every lighting fixture shall be permanently marked with the maximum permissible wattage of the lamps to be fitted.

4 Mounting of lighting fixtures

4.1 General

4.1.1 All lighting fixtures are to be mounted in such a way that combustible structural elements such as wood etc. will not be ignited by the heat produced and the lighting fixtures themselves are not exposed to damage.

4.1.2 In bathrooms and shower rooms lighting fixtures shall be mounted in accordance with IEC.

5 Lighting systems

5.1 Construction and extent of the main lighting system

5.1.1 There is to be a main lighting system supplied by the main source of electrical power and illuminating all parts of the unit normally accessible to the public and staff.

5.2 Construction and extent of the emergency lighting system

5.2.1 Construction

An emergency lighting system is to be installed, the extent of which shall conform to [5.2.2].

The power supply and the duration of the supply shall conform to Ch 2, Sec 2, [3].

As far as practicable the emergency lighting system shall be installed in a manner, that it will not be rendered unserviceable by a fire or other incident in rooms in which the main source of electrical power, any associated transformers, the main switchboard and the main lighting distribution panel are installed.

The emergency lighting system shall be cut in automatically following a failure of the main power supply. Local switches are to be provided only where it may be necessary to switch off the emergency lighting.

Emergency lights must be marked as such for ease of identification.

5.2.2 Extent

a) Adequate emergency lighting must be provided in the following areas:

- positions at which collective life-saving appliances are stored and at which they are normally prepared for use
  - escapes, exits, connecting passageways, lifts and stairways in the accommodation area
  - marking indicating escapes and exits
  - machinery spaces and their exits
  - space of the emergency power source
  - locations of fire extinguishers and fire pumps
  - rooms in which public and staff assemble in an emergency.

5.2.3 If a unit is divided into main fire zones, at least two circuits are to be provided for the lighting of each main fire zone, and each of these must have its own power supply line. One circuit shall be supplied from the emergency power source. The supply lines are to be so located that, in the event of a fire in one main fire zone, the lighting in the other zones is as far as practicable maintained.

5.3 Final subcircuits

5.3.1 In the important spaces mentioned below the lighting shall be supplied by at least two different circuits:

- passageways
- stairways leading to the boat deck, and public spaces and day rooms for public and staff
- large galleys.

The lamps are to be so arranged that adequate lighting is maintained even if one of the circuits fails.

5.4 Lighting of engine rooms

5.4.1 The lighting equipment of engine rooms is to be distributed on two or more circuits so that there still remains sufficient lighting to enable work to continue if there is failure of a circuit.

SECTION 10 INSTALLATION MATERIAL

1 Design and mounting

1.1

1.1.1 Installation appliances shall be adequately protected against mechanical damage and shall be made of corrosion-resistant materials.

Where appliances with casings of brass or other copper alloys are fixed to aluminium surfaces, they shall be insulated from the latter to protect them against corrosion.

1.1.2 The cable entries of the appliances shall be of a size compatible with the cables to be connected and shall be selected to suit the type of cable concerned.

1.1.3 The space inside appliances shall be sufficient to enable insulated conductors to be connected without having to make sharp bends. Corners, edges and projections shall be well rounded.

1.1.4 Mobile appliances are to be provided with means of relieving tension in the cable so that the conductors are not subjected to tensile load.

1.1.5 Terminals, screws and washers shall be made of brass or another corrosion-resistant material.

2 Plug connections and switches

2.1

2.1.1 The live contact components of sockets (outlets) and plugs shall be so enclosed that they cannot be touched under any circumstances, even during insertion of the plug.

2.1.2 The sockets for amperages over 16 A shall be interlocked with a switch in such a way that the plug can be neither inserted nor withdrawn as long as the socket contact sleeves are live.

2.1.3 Where a unit is provided with sockets for a variety of distribution systems differing in voltage or frequency, use is to be made of sockets and plugs which cannot be confused in order to ensure that an appliance cannot be connected to a socket belonging to the wrong system.

2.1.4 Plug connections shall conform to the required class of enclosure irrespective of whether or not the plug is in or out.

2.1.5 Wherever possible, appliances are to be so designed and mounted that the plugs are inserted from below.

2.1.6 Apart from the sockets standardized and specifically approved for use in shipbuilding practice, accommodation and day rooms may also be provided with sockets designed for use on shore provided that they are mounted in a dry position.

2.1.7 Only sockets with a permissible operating voltage in accordance with Ch 2, Sec 1, Tab 7 are allowed in washrooms and bathrooms. No sockets or switches may be fitted in shower cubicles, shower cabinets or close to bathtubs. Exempted from this rule are razor sockets with an isolating transformer.

2.1.8 Switches shall simultaneously connect and disconnect all the non-earthed conductors of a circuit. Single-pole disconnection is permitted only in the accommodation area for the switches of lighting circuits not carrying more than 16 A.

2.1.9 No plug connections are normally to be provided in cargo holds.

Where power sockets are essential in special cases, e.g. for supplying power to refrigerated containers, they are to be supplied from their own subdistribution boards with fused outlet switches which can be centrally disconnected and are located outside the cargo holds.

The subdistribution boards shall be provided with devices indicating when they are live and which outlets are connected/disconnected.

Sockets may only be installed at locations which give adequate protection against mechanical damage.

SECTION 11 CABLES AND INSULATED WIRES

1 General

1.1

1.1.1 All electrical cables used on board are to be of type approved. As a general principle, the use of the types of cables and wires according to IEC 60092 is permitted. In addition, equivalent cables and lines may be approved by the Society.

1.1.2 Except for lighting and space heating, only cables with multi-strand conductors are to be used.

1.1.3 The voltage rating of a cable may not be less than the rated working voltage of the relevant circuit.

In insulated distribution systems the outer conductor voltage of the system is to be deemed to be the rated voltage of the cable between a conductor and the unit's hull, because in the event of a fault, e.g. outer conductor shorting to earth, this voltage may occur for a prolonged period between an intact outer conductor and the unit's hull.

2 Choice of cables

2.1 Temperatures

2.1.1 In positions liable to be subjected to high ambient temperatures, only cables whose permissible temperature is at least 10 K above the maximum ambient temperature to be expected may be used. A correction factor is to be applied to the permissible loading (see Tab 1).

Cables on diesel engines, heaters etc. liable to be exposed to high temperatures are to be routed so that they are protected against excessive external heating. If this is not possible, oil-resistant cables with high heat resistance are to be used. Cables not previously used are to be submitted to the Society for approval before installation.

2.2 Fire resistance

2.2.1 Cables and insulated wires shall be flame-retardant (IEC 60332) and self-extinguishing.

2.3 Cable sheaths

2.3.1 On open decks, in damp or wet rooms, in service rooms and wherever condensation or harmful vapours (oil vapours) may occur, only cables with impermeable sheaths resistant to the environmental influences may be used.

PVC (polyvinyl chloride), CSP (chlorosulphonated polyethylene) and PCP (polychloroprene) sheaths are deemed to fall into this category, although they are unsuitable for long-term immersion in liquids.

2.4 Movable connections

2.4.1 Machines or equipment mounted on rubber or spring vibration absorbers are to be connected via cables or wires with sufficient flexibility.

Mobile equipment is in all cases to be supplied by heavy, flame-retardant and oil-resistant rubber-sheathed flexible cords such as HO7RN-F-CENELEC HD 22 or equivalent.

For working voltages above 50 V, the movable connecting cables or wires for non-double-insulated equipment shall include an earthed conductor, which is to be specifically marked.

In spaces in the accommodation area, lightweight flexible cords are also permitted.

3 Determination of conductor cross sections

3.1 General requirements

3.1.1 The sizes of cables and wires are to conform to the details in Tab 3 respectively in Tab 4 unless other conductor cross-sections are necessitated by the permissible voltage drop for particular equipment items (see [3.1.3]) or by the elevated ambient temperature or by a special permissible working temperature (see also [3.2.1] - Minimum cross sections). See Tab 1 for the correction factor.

Table 1 : Correction factors for cables in higher ambient temperatures

Maximum permissible conductor operating temperature		Ambient temperature, in °C				
°C	Table	40	45	50	60	70
60	Tab 3	1	0,87	0,71	-	-
85	Tab 4	1	0,94	0,89	0,74	0,57

3.1.2 Parallel cables may be calculated with the sum of their permissible loads and may be fused in common provided that the current is equally shared between all the parallel cables.

In every case, only cables of the same cross-sectional area and length shall be used as parallel cables.

3.1.3 The cross-section of cables and wires is to be determined not only by reference to the permissible current load but also according to the permissible voltage drop. The voltage drop between the main switchboard and the most unfavourable point of the system under consideration may not exceed 5% for lighting or 7% for power and heating circuits. In the case of transient loads, caused for example by start-ups, it is necessary to ensure that the voltage drop in the cable does not occasion any malfunction of the system.

3.2 Minimum cross-sections

3.2.1 The minimum cross-section of permanently laid cables and wires in power, heating, lighting systems and control circuits for power plants shall be 1,0 mm²; in control circuits of safety systems 0,75 mm²; in automation and telecommunication equipment 0,5 mm²; in telecommunication systems not relevant to the safety of the unit and for data bus/data cables 0,2 mm².

Within accommodation and day rooms, flexible leads with a conductor cross-section of 0,75 mm² and over may also be used for the mobile connection of appliances with a current input of up to 6 A.

3.3 Hull return conductors

3.3.1 See Ch 2, Sec 6, [2.1]

3.4 Protective earth wires

3.4.1 See Ch 2, Sec 1, [4.4.4]

3.5 Neutral conductors of 3-phase systems

3.5.1 The cross-section of neutral conductors of 3-phase systems is to equal at least half that of the outer conductors. Where the cross-section of the outer conductors is 16 mm² or less, the cross-section of the neutral conductor shall equal that of the outer conductors.

4 Cable overload protection

4.1 General requirements

4.1.1 All cables and wires with the exception of hull return, neutral and earthing conductors are to be fitted with fuses in accordance with Tab 3 respectively Tab 4.

4.1.2 Where protection is afforded by power circuit breakers with overcurrent and short-circuit trip, the overcurrent trip is to be set in accordance with the maximum permissible current loads shown in Tab 3 respectively Tab 4. The short-circuit trip shall be set to 4-6 times the indicated amperages.

For short-circuit protection, see also Ch 2, Sec 7, [3.9.1].

4.1.3 The exciter conductors of DC motors and DC generators operating in parallel may not be fitted with fuses except in the case of special installations. The exciter conductors of individually connected DC generators and 3-phase synchronous machines may be fused only where there are special grounds for doing so, e.g. where the cables are run through several of the unit's main vertical zones.

5 Cable laying

5.1 General

5.1.1 Cables from generators and all cables going out from the main or emergency switchboard up to the distribution boards or the power consumers themselves shall be laid undivided and in a single length. The same applies to all connecting cables in essential systems. Exemptions are subject to the Society's express approval.

For elastically mounted machinery and equipment, adequate freedom of movement shall be ensured by compensation bends.

5.1.2 In DC systems without hull return multi-core cables are to be used for the smaller cross-sections. When using single-core cables for large cross-sections, the outgoing and return lines shall be laid as close as possible to each other over their entire length to avoid stray magnetic fields.

5.1.3 In 3-phase systems without hull return, 3-core cables are to be used for 3-phase connections; and 4-core cables are to be used for circuits with charged neutral. The use of a 3-core cable and a separate neutral conductor is only permissible if the current in the latter does not exceed 20 A.

5.1.4 In single or 3-phase AC systems, single-core cables carrying a current above 20 A are to be avoided. If such a method of installation cannot be avoided, the measures to be taken are to be agreed with the Society.

5.1.5 Cables whose maximum permissible temperature of the conductor differ by more than 5 K from each other may be laid in a common bundle only if the permissible loadings of the lowest-capacity type are taken as the basis for all cables.

5.1.6 Should it be impossible to use multi-core cables in accordance with [5.1.3] in single or 3-phase AC systems because of the connection difficulties associated with high power ratings, approval may be given for the laying of single-core cables and wires subject to compliance with special requirements which are to be agreed with the Society in each case.

5.1.7 Tab 2 indicates the minimum internal radius of curvature of cable bends according to the type and outside diameter of the cable concerned.

Table 2 : Minimum internal radius of curvature

Outer diameter of cable (D), in mm	Cables without metal sheath or braid	Cables with metal sheath or braid
up to 25	4 D	6D
over 25	6 D	6D

Table 3 : Current rating of cables with a maximum permissible conductor temperature of 60°C at an ambient temperature of 40°C

1	2	3	4	5	6	7
Nominal cross-section of the copper conductor, in mm^2	Continuous service		Short time service S 2 = 30 min.		Short time service S 2 = 60 min.	
	Maximum permissible current	Rated fuse current	Maximum permissible current	Rated fuse current	Maximum permissible current	Rated fuse current
	[A]	[A]	[A]	[A]	[A]	[A]
Single-core cables						
1,0	9	10	10	10	10	10
1,5	14	16	15	15	15	15
2,5	19	20	20	20	20	20
4	26	25	28	25	28	25
6	34	36	36	36	36	36
10	46	50	49	50	49	50
16	62	63	66	63	66	63
25	82	80	87	80	87	80
35	101	100	108	100	107	100
50	126	125	136	160	134	160
70	156	160	171	160	165	160
95	189	160	217	224	202	200
120	219	224	251	250	234	224
150	251	250	294	300	271	250
185	287	250	353	315	311	300
240	337	315	420	-	371	-
300	388	355	500	-	435	-
Two-core cables						
1,0	8	6	9	10	9	10
1,5	11	10	12	16	12	16
2,5	17	16	18	20	18	20
4	22	20	23	25	23	25
6	29	25	31	25	31	25
10	39	36	41	36	41	36
16	53	50	60	63	56	63
25	70	63	83	80	75	80
Three or four-core cables						
1,0	6	6	7	10	7	10
1,5	9	10	10	10	10	10
2,5	14	16	15	16	15	16
4	18	20	19	20	19	20
6	24	25	25	25	25	25
10	32	36	36	36	34	36
16	43	36	50	50	46	50
25	57	50	70	63	60	63
35	71	63	88	80	75	80
50	89	80	115	100	100	100
70	109	100	151	125	125	125
95	132	125	194	200	161	160
120	153	160	234	225	161	200
5 to 24-core cables 1,5 mm^2						
5	8	6				
7	7	6				
10	6	6				
12	6	6				
14	6	6				
16	6	6				
19	5	4				
24	5	4				

Table 4 : Current rating of cables with a maximum permissible conductor temperature of 85°C at an ambient temperature of 40°C

1	2	3	4	5	6	7
Nominal cross-section of the copper conductor, in mm²	Continuous service		Short time service S 2 = 30 min.		Short time service S 2 = 60 min.	
	Maximum permissible current	Rated fuse current	Maximum permissible current	Rated fuse current	Maximum permissible current	Rated fuse current
	[A]	[A]	[A]	[A]	[A]	[A]
Single-core cables						
1,0	17	16	18	16	18	20
1,5	22	20	23	20	23	20
2,5	30	25	32	25	32	36
4	40	36	42	36	42	50
6	52	50	55	50	55	63
10	72	63	76	63	76	80
16	96	100	102	100	102	100
25	127	125	135	125	135	160
35	157	160	168	160	166	224
50	196	200	212	224	208	250
70	241	224	264	300	255	300
95	292	300	327	315	311	315
120	338	315	387	-	362	-
150	389	400	455	-	420	-
185	443	425	532	-	481	-
240	522	500	650	-	574	-
300	600	630	765	-	672	-
Two-core cables						
1,0	14	10	15	16	15	16
1,5	19	20	20	20	20	20
2,5	26	25	28	25	28	25
4	34	36	36	36	36	36
6	44	36	47	50	47	50
10	61	63	65	63	65	63
16	82	80	93	100	87	100
25	108	100	127	125	115	125
Three or four-core cables						
1,0	12	10	13	16	13	16
1,5	15	16	16	16	16	16
2,5	21	20	22	25	22	25
4	28	25	30	36	30	36
6	36	36	38	36	38	36
10	50	50	56	63	53	50
16	67	63	75	80	71	63
25	89	80	110	100	96	80
35	110	100	138	125	120	100
50	137	125	178	160	153	125
70	169	160	235	224	194	160
95	205	200	300	300	250	250
120	237	224	365	315	296	300
5 to 24-core cables 1,5 mm²						
5	13	10				
7	11	10				
10	10	10				
12	10	10				
14	9	6				
16	9	6				
19	8	6				
24	8	6				

6 Cable runs

6.1 General

6.1.1 Cable runs are to be so selected that cables can, wherever possible, be laid in straight lines and are not exposed to mechanical damage. Continuous cable runs shall not be routed along the shell plating and its frames.

6.1.2 Sources of heat such as boilers, hot pipes etc. shall be by-passed to avoid exceeding the permissible end temperature of the cable conductors. Where this is not possible, the cables are to be shielded from radiant heat.

6.1.3 Where, for safety reasons, an installation is provided with double feeder cables, these are to be laid as far apart as possible.

Cable runs are to be protected against corrosion.

7 Fastening of cables and wires

7.1 General

7.1.1 Cables are to be fastened to trays or carriers. Individually run cables are to be fixed with clips.

7.1.2 Cables and wires are to be fastened with clips, straps or bindings made of galvanized steel strip, copper or brass strip.

Other established fastenings approved by the Society may also be used.

Cadmium coated or galvanized steel screws and galvanized clips or fastenings of other suitable materials are to be used for fixing cables to aluminium surfaces.

Clips used for mineral-insulated copper-sheathed cables shall be made of copper alloy if in electrical contact with the cable-sheath.

8 Tension relief

8.1 General

8.1.1 Cables are to be fastened in such a way that any tensile loads are kept within the permissible limits. This is particularly applicable to cables with a small cross-section and to those installed in vertical trays or vertical ducts.

9 Protection against mechanical damage

9.1 General

9.1.1 Cables on deck and in locations where they are particularly exposed to the danger of mechanical damage, including especially cables laid up to a height of 500 mm above floor, are to be provided with additional protection in form of sheaths or ducts.

Cable coverings are to be conductively connected to the unit's hull.

10 Laying of cables and wires in conduits or enclosed metal ducts

10.1 General

10.1.1 Conduits and ducts shall be smooth on the inside and shall have ends shaped to avoid damaging the cable covering or sheath. They are to be provided with drainage holes measuring at least 10 mm in diameter.

Bores and bending radii shall be such as to enable the cables to be inserted without difficulty.

10.1.2 Cables may only occupy up to a maximum of 40% of the clear cross-section of conduits and ducts, the aggregate cross-section of the cables being the sum of the individual cross-sections calculated from the cable diameters.

10.1.3 Extensive cable ducts and conduits are to be fitted with inspection and draw containers.

11 Laying in non-metallic conduits and ducts

11.1 general

11.1.1 The conduits or ducts shall be made of flame-retardant material.

12 Bulkhead and deck penetrations

12.1 General

12.1.1 Where cables pass through bulkheads or decks, the cable penetrations shall not impair the mechanical strength, watertightness or fire resistance of the bulkheads and decks concerned.

12.1.2 Cable lead-throughs in watertight bulkheads or decks are to take the form of individual gland-type lead-throughs or, in the case of cable bundles, collective lead-throughs of a type approved by the Society. Sealing may be effect with casting resins or elastic plugs.

If casting resin is used, the cables shall be run and encased in the resin over a length of at least 150mm inside the lead-through.

13 Cables laid in refrigerated spaces

13.1 General

13.1.1 Cables may be laid neither in nor directly upon the thermal insulation of these spaces. They are to be installed on perforated metal plates or spacing clips clear of the covering of the insulating layer. Excepted from this are individual cables with plastic outer sheathing, which may be laid directly on the insulation covering.

14 Cable laying using extending cable feeds (moveable cable loops)

14.1 General

14.1.1 The following points are to be specially considered when selecting and laying the cables for variable-height control platforms:

- Choice of cable types possessing the necessary flexibility and resistance to oil and to high and low temperatures (e.g. HO7RN-F)
- Use of increased bending radii at locations subject to severe mechanical loads
- Cable attachment using metal cable straps or clips
- Suitable protection against mechanical damage.

15 Cable junctions and branches

15.1 General

15.1.1 Branches from cables and wires may only be made inside containers.

15.1.2 Junction and distribution containers shall be located in easily accessible positions and shall be clearly marked.

15.1.3 As a general principle, only one circuit shall be led through any one box. Should it be necessary to lead a larger number of circuits through one box, the terminals are to be so arranged that similar circuits are adjacent to each other. The terminals for dissimilar systems or for systems with different working voltages are to be separated from each other by partitions. All terminals are to be clearly and indelibly marked. A terminal connection diagram is to be mounted on the box cover.

15.1.4 It is necessary to effect the continuous conductive connection of all metal cable sheaths, particularly inside cable distribution and junction containers.

Metal cable sheaths, armouring, screening and shielding shall normally be conductively connected to the vessel's hull at both ends. In the case of single-core cables in single phase AC systems, only one end is to be earthed. The earthing at one end only of cables and wires in electronic systems is recommended.

SECTION 12 CONTROL, MONITORING, ALARM AND SAFETY SYSTEMS

1 Scope

1.1 General requirements

1.1.1 This Section sets out requirements for the control, monitoring, alarm and safety systems necessary to operate essential equipment for unit's safety.

1.2 Planning and design

1.2.1 The design of safety measures, open and closed loop controls and monitoring of equipment must limit any potential risk in the event of breakdown or defect to a justifiable level of residual risk.

1.2.2 Where appropriate, the following basic requirements shall be observed:

- compatibility with the environmental and operating conditions
- compliance with accuracy requirements
- recognizability and constancy of the parameter settings, limiting and actual values
- compatibility of the measuring, open and closed loop controls and monitoring systems with the process and its special requirements
- immunity of system elements to reactive effects in overall system operation
- non-critical behaviour in the event of power failure, restoration and of faults
- unambiguous operation
- maintainability, the ability to recognize faults and test capability
- reproducibility of values.

1.2.3 Automatic interventions shall be provided where damage cannot be avoided by manual intervention.

1.2.4 If dangers to persons or the safety of the unit arising from normal operation or from faults or malfunctions in machinery or plant, or in control, monitoring and measuring systems, cannot be ruled out, safety devices or safety measures are required.

1.2.5 If dangers to machinery and systems arising from faults or malfunctions in control, monitoring and measuring systems cannot be ruled out, protective devices or protective measures are required.

1.2.6 Where mechanical systems or equipment are either completely or partly replaced by electric / electronic equipment, the requirements relating to mechanical systems and electric / electronic equipment shall be met accordingly.

1.3 Design and construction

1.3.1 Machinery alarm systems, protection and safety systems, together with open and closed loop control systems for essential equipment shall be constructed in such a way that faults and malfunctions affect only the directly involved function. This also applies to measuring facilities.

1.3.2 For machinery and systems which are controlled remotely or automatically, control and monitoring facilities must be provided to permit independent manual operation.

Manual operation shall override all remote and automatical control.

1.3.3 In the event of disturbances automatically switched off plants shall not be released for restarting until having been manually unlocked.

1.4 Maintenance

1.4.1 Access must be provided to systems to allow measurements and repairs to be carried out. Facilities such as simulation circuits, test jacks, pilot lamps etc. are to be provided to allow functional checks to be carried out and faults to be located.

1.4.2 The operational capability of other systems shall not be impaired as a result of maintenance procedures.

1.4.3 Where the replacement of circuit boards in equipment which is switched on may result in the failure of components or in the critical condition of systems, a warning sign must be fitted to indicate the risk.

1.4.4 Circuit boards and plug-in connections must be protected against unintentional mixing up. Alternatively they must be clearly marked to show where they belong to.

2 Machinery control and monitoring installations

2.1 Safety devices

2.1.1 The design of safety devices shall be as simple as possible and must be reliable and inevitable in operation. Proven safety devices which are not depending on a power source are to be preferred.

2.1.2 The suitability and function of safety devices must be demonstrated in the given application.

2.1.3 Safety devices shall be designed so that potential faults such as, for example, loss of voltage or a broken wire shall not create a hazard to human life, unit or machinery.

These faults and also the tripping of safety devices shall be signalled by an alarm.

2.1.4 The adjustment facilities for safety devices shall be designed so that the last setting can be detected.

2.1.5 Where auxiliary energy is needed for the function of safety devices, this has to be monitored and a failure has to be alarmed.

2.2 Safety systems

2.2.1 Safety systems shall be independent of open and closed loop control and alarm systems. Faults in one system shall not affect other systems.

Deviations from this requirement may be allowed for redundant equipment where this would entail no risk to human life and where unit safety would not be compromised.

2.2.2 Safety systems shall be assigned to systems which need protection.

2.2.3 Where safety systems are provided with overriding arrangements, these shall be protected against unintentional operation. The actuation of overriding arrangements shall be indicated and recorded.

2.2.4 The monitored open-circuit principle shall be used for safety systems. Alternatively, the closed circuit principle shall be applied where the provisions of national Regulations demand it.

Equivalent monitoring principles are permitted. Faults, and also the tripping of safety systems shall be indicated by an alarm and recorded.

2.2.5 Safety systems shall be designed for preference using conventional technology (hard wired).

2.2.6 The power supply shall be monitored and loss of power shall be indicated by an alarm and recorded.

The power supply to the safety system is to be maintained for at least 15 minutes following a possible failure of the unit's general supply network. Separate provision shall be made for this.

2.2.7 Safety systems are to perform the following functions when hazard limits are reached:

a) Temporary adaptation of operation to the remaining possibilities (slow down or signal to reduce power)

b) Protection of machinery from critical operating conditions (shutdown or signal to shut down).

Within certain limits, safety systems provide redundancy for the alarm system.

2.3 Open loop control

2.3.1 Essential equipment shall be provided with effective means for the control of its operation. All controls for essential equipment shall be independent or so designed that failure of one system does not impair the performance of other systems, see also [1.2.2].

2.3.2 Control equipment must have built-in protection features where incorrect operation would result in serious damage or in the loss of essential functions.

2.3.3 The consequences of control commands must be indicated at the respective control station.

2.3.4 Controls shall correspond with regard to their position and direction of operation to the system being controlled respective to the direction of motion of the unit.

2.3.5 It shall be possible to control the essential equipment at or near to the equipment concerned.

2.3.6 Where controls are possible from several control stations, the following shall be observed:

- Competitive commands shall be prevented by suitable interlocks. The control station in operation must be recognizable as such.
- Taking over of command shall only be possible with the authorization of the user of the control station which is in operation.
- Precautions shall be taken to prevent changes to desired values due to a change-over in control station.

2.3.7 Open loop control for speed and power of engines are subject to mandatory type testing.

2.4 Closed loop control

2.4.1 Closed loop control shall keep the process variables under normal conditions within the specified limits.

2.4.2 Closed loop controls must maintain the specified reaction over the full control range. Anticipated variations of the parameters must be considered during the planning.

2.4.3 Defects in a control loop shall not impair the function of operationally essential control loops.

2.4.4 The power supply of operationally essential control loops shall be monitored and power failure must be signalled by an alarm.

2.4.5 Closed loop control for speed and power of engines are subject to mandatory type testing.

2.5 Alarm systems

2.5.1 Alarm systems shall indicate unacceptable deviations from operating figures optically and audibly. The operative state of the system is to be indicated in the control station and on the equipment.

2.5.2 Alarm delays shall be kept within such time limits that any risk to the monitored system is prevented if the limit value is exceeded.

2.5.3 Optical signals shall be individually indicated. The meaning of the individual indications must be clearly identifiable by text or symbols.

If a fault is indicated, the optical signal must remain visible until the fault has been eliminated. It must be possible to distinguish between an optical signal which has been acknowledged and one that has not been acknowledged.

2.5.4 It must be possible to acknowledge audible signals.

The acknowledgement of an alarm shall not inhibit an alarm which has been generated by new causes. Alarms must be discernible under all operating conditions.

Where this cannot be achieved, for example due to the noise level, additional optical signals, e.g. flashing lights must be installed.

2.5.5 Transient faults which are self-correcting without intervention shall be memorized and indicated by optical signals which shall only disappear when the alarm has been acknowledged.

2.5.6 Alarm systems shall be designed according to the closed-circuit principle or the monitored opencircuit principle. Equivalent monitoring principles are permitted.

2.5.7 The power supply shall be monitored and a failure shall cause an alarm. Test facilities are required for the operation of light displays.

The alarm system shall be supplied from the main power source and shall have battery support for at least 15 minutes.

2.5.8 Alarms are to be given at manned location in the machinery control position, if any, or in the control station and are to take the form of individual visual displays and collective audible signals. The audible alarm shall sound throughout the whole machinery space, at manned location in the machinery control position and at the control station. If this cannot be ensured because of the noise level, additional visual alarms such as flash signals shall be installed.

Simultaneously with a collective alarm signal, an acknowledgeable audible alarm shall be given at manned location in the machinery control position and in the control station which, following acknowledge, shall be available for further signals. It must be possible to stop audible signals independently of acknowledging the visual signal. Acknowledgement of optical alarms shall only be possible where the fault has been indicated as an individual signal and a sufficient overview of the concerned process is been given.

2.5.9 Where the alarm system contents individual visual displays in the machinery space, the visual fault signals in the control station may be arranged in at least three groups as collective alarms in accordance with their urgency, if this is necessary due the scope of the plant.

- Group 1: Alarms signalling faults which require immediate shutdown of the main auxiliary engine (red light).
- Group 2: Alarms signalling faults which require a reduction in power of the main auxiliary engine (red light).
- Group 3: Alarms signalling faults which do not require Group 1 or Group 2 measures (yellow light).

2.5.10 Pressure alarms may in general not be delayed by more than 2 s. Level alarms are to be delayed sufficiently to ensure that the alarm is not tripped by brief fluctuations in level.

2.5.11 A failure of the power supply or disconnection of the system shall not alter the limit value settings at which a fault is signalled.

2.5.12 The fault signalling systems of main auxiliary engines with engine-driven pumps are to be so designed that variations in operating parameters due to manoeuvres do not trip the alarm.

2.5.13 It is recommended that input devices approved by the Society should be used.

2.5.14 It is recommended that the alarm signals should be automatically suppressed when the main auxiliary engine and other auxiliaries are taken out of service.

2.6 Integration of systems for essential equipment

2.6.1 The integration of functions of independent equipment shall not decrease the reliability of the single equipment.

2.6.2 A defect in one of the subsystems (individual module, unit or subsystem) of the integrated system shall not affect the function of other subsystems.

2.6.3 Any failure in the transfer of data of autonomous subsystems which are linked together shall not impair their independent function.

2.6.4 Essential equipment must also be capable of being operated independently of integrated systems.

2.7 Control of machinery installations

2.7.1 Machinery installations are to be equipped with monitoring equipment as detailed in Tab 1.

2.7.2 It shall be ensured that control is only possible from one control station at any time. Transfer of command from one control station to another shall only be possible when the respective control levers are in the same position and when a signal to accept the transfer is given from the selected control station. A display at each control station shall indicate whether the control station in question is in operation.

Table 1 : Control of machinery installations

Symbol convention H = High, HH = Very high L = Low I = Individual alarm G = Group alarm		Monitoring				
Identification of system parameter		Alarms	Indication local	Alarms control station **(3)**	Indication control station	Shut down
AUXILIARY MACHINE (2)						
Engine speed	All engines		x			
	Engine power > 220 kW	HH	x	G		x
Low pressure cooling water system **(1)**		L	x	G		
Fresh cooling water system outlet temperature **(1)**		H	x	G		
Lubricating oil pressure		L	x	G		
Fault in the electronic governor		x	x	G		
ELECTRICITY						
Earth fault (when insulated network)		x	x	G		
Main supply power failure		x	x	G		
FUEL OIL TANKS						
Fuel oil level in service tank or tanks supplying directly services essential for safety		L	x	G		
FIRE						
Fire detection		x			x	
Fire manual call point		x			x	
Automatic fixed fire extinguishing system activation, if fitted		x			x	
FLOODING						
Level of machinery space bilges/drain wells		x			x	
ALARM SYSTEM						
Alarm system power supply failure		x	x		x	

(1) A combination of level indication/alarm in expansion tank and indication/alarm cooling water temperature can be considered as equivalent with consent of the Society
(2) Exemptions can be given for diesel engines with a power of 50 kW and below
(3) Group of alarms are to be detailed in the machinery space or control room (if any)

SECTION 13 TESTS ON BOARD

1 General

1.1

1.1.1 The tests are divided into:

- tests during construction
- tests during commissioning.

2 Tests during construction

2.1

2.1.1 During the period of construction of the unit, the installations shall be checked for conformity with the documents reviewed/approved by the Society and with the Rules for construction.

2.1.2 Test certificates for tests which have already been performed shall be presented to the Surveyor on request.

2.1.3 Protective measures

a) protection against foreign bodies and water

b) protection against electric shock, such as protective earthing, protective separation or other measures as stated in Ch 2, Sec 1

c) measures of explosion protection.

2.1.4 Testing of the cable network

Inspection and testing of cable installation and cable routing with regard to:

a) acceptability of cable routing with regard to:
   - separation of cable routes
   - fire safety
   - reliable supply of emergency consumers (where applicable)

b) selection and fixation of cables

c) construction of bulkhead and deck penetrations

d) insulation resistance measurement.

3 Testing during commissioning of the electrical equipment

3.1

3.1.1 General

Proofs are required of the satisfactory condition and proper operation of the main and emergency power supply systems, as well as of all the other installations specified in the Rules for construction.

Unless already required in the Rules for construction, the tests to be performed shall be agreed with the Society's Surveyor in accordance with the specific characteristics of the subject equipment.

3.1.2 Generators

A test run of the generator sets shall be conducted under normal operating conditions, and shall be reported on appropriate form.

3.1.3 Storage batteries

The following shall be tested:

a) installation of storage batteries

b) ventilation of battery rooms, cupboards/containers, and cross-sections of ventilation ducts

c) storage-battery charging equipment

d) the required caution labels and information plates.

3.1.4 Switchgear

The following items shall be tested under observance of:

a) accessibility for operation and maintenance

b) protection against the ingress of water and oil from ducts and pipes in the vicinity of the switchboards, and sufficient ventilation

c) equipment of main and emergency switchboards with insulated handrails, gratings and insulating floor coverings

d) correct settings and operation of protection devices and interlocks.

The Society reserves the right to demand the proof of selective arrangement of the vessel supply system.

3.1.5 Power plants

The following items shall be tested:

a) Motor drives together with the driven machines, which shall, wherever possible, be subjected to the most severe anticipated operating conditions

   This test shall include a check of the settings of the motors' short-circuit and overcurrent protection devices

b) The emergency remote stops of equipment such as engine room fans and boiler blowers

c) Closed loop controls, open loop controls and all electric safety devices.

3.1.6 Control, monitoring and unit's safety systems

For these systems operational tests shall be performed.

Part C
Machinery, Systems and Electricity

Chapter 3
FIRE PROTECTION, DETECTION AND EXTINCTION

SECTION 1 GENERAL

1 General

1.1 Application

1.1.1 This Chapter applies to fire protection, fire detection and fire extinction equipment on all floating establishments.

1.1.2 Fire extinguishing systems not dealt with in these Rules are to be in compliance with the applicable Society's Rules.

1.2 Fire protection and safety principle

1.2.1 The fire protection and safety measures are determined according to the following:

- the unit mission
- the unit category, defined in Pt A, Ch 1, Sec 2, [1.7.4]
- the distance H with respect to evacuation deck, defined in Pt B, Ch 1, Sec 2, [1.12]
- the building method and subdividing partitions
- Rescue access routes and the time required by the firemen to arrive on site.

1.3 Application criteria

1.3.1 Unless expressly provided otherwise:

a) requirements not referring to a specific unit additional service feature or additional class notation apply to all units.

b) additional requirements on fire protection, fire detection and fire extinction applicable to specific unit additional service features are given in Part D, Chapter 1.

1.3.2 Moreover, depending on the availability of the rescue access routes and the time required by the firemem to arrive on site, alternative requirements may be applied if the criteria defined in [1.3.3] are fulfilled.

1.3.3 Criteria for application of alternative requirements

a) The floating establishment is located at a distance to a shore rescue access route not exceeding 60 m and:
   - the shore is equipped for fire fighting in compliance with applicable land-based building statutory Rules
   - two access footbridges adequately distributed and having, each, a minimum clear width of 0,90 m, designed in compliance with Pt B, Ch 7, Sec 3, [1], are provided for, or one access footbridge having a minimum clear width of 1,40 m and one exit footbridge having a minimum clear width of 0,60 m, designed in compliance with Pt B, Ch 7, Sec 3, [1], are provided for.

b) If the distance of the unit to a shore rescue access route exceeds 60 m, a fire vessel is available in the operating area of the unit.

c) Availability of a warning system

   It shall be possible to alert immediately the public service of assistance and fire fighting.

1.4 Statutory Rules

1.4.1 Where available, applicable statutory Rules in the operating area of the unit are to be complied with.

1.5 Documentation to be submitted

1.5.1 The documents listed in Tab 1 are to be submitted to the Society.

1.6 Type approved products

1.6.1 The following materials, equipment, systems or products in general used for fire protection are to be type approved by the Society, except for special cases for which the acceptance may be given for individual units on the basis of suitable documentation or ad hoc tests.

Exceptions to these Rules compatible with the statutory Regulations of the unit's country of registration may be agreed with the Society.

a) Fire-resisting and fire-retarding divisions (bulkheads or decks) and associated doors

b) Fire dampers

c) Hoses

d) Water spray nozzles

e) Discharge nozzles

f) Extinguishing agents

g) Portable fire extinguishers

h) Detection and alarm system.

The Society may request type approval for other materials, equipment, systems or products required by the applicable provisions for units or installations of special types.

Table 1 : Documentation to be submitted

No	I/A (1)	Document (2)
1	A	Structural fire protection, showing the method of construction, purpose and category of the various spaces of the vessels, the fire rating of bulkheads and decks, means of closings of openings in A and B class divisions, draught stops
2	A	Natural and mechanical ventilation systems showing the penetrations on A class divisions, location of dampers, means of closing, arrangements of air conditioning rooms
3	A	Specifications of material properties with regards to fire protection.
4	A	Means of escape and, where required, the relevant dimensioning. Escape route signage
5	A	Automatic fire detection systems and manually operated call points
6	A	Fire pumps and fire main including pumps head and capacity, hydrant and hose locations
7	A	Arrangement of fixed fire-extinguishing systems (2)
8	A	Arrangement of sprinkler systems including the capacity and head of the pumps (2)
9	A	Fire control plan
10	A	Electrical diagram of the fixed gas fire-extinguishing systems
11	A	Electrical diagram of the sprinkler systems
12	A	Electrical diagram of power control and position indication circuits for fire doors
13	I	General arrangement plan

(1) A : to be submitted for review/approval
I : to be submitted for information

(2) Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification such as:
- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces, for gas and foam fire-extinguishing systems
- surface areas of protected zones for automatic sprinkler and pressure water-spraying, low expansion foam and powder fire-extinguishing systems
- capacity, in volume and/or in mass, of vessels or bottles containing the extinguishing media or propelling gases, for gas, automatic sprinkler, foam and powder fire-extinguishing systems
- type, number and location of nozzles of extinguishing media for gas, automatic sprinkler, pressure water-spraying, foam and powder fire-extinguishing systems.

All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.

2 Definitions

2.1 Accommodation spaces

2.1.1 Accommodation spaces are spaces intended to be used by the public and/or staff, including galleys, storage spaces, toilets and washing facilities, laundry facilities, etc.

2.2 Muster areas

2.2.1 Muster areas are areas of the unit which are specially protected and in which persons muster in the event of danger.

2.3 Atriums

2.3.1 Atriums are public spaces within a single main fire zone spanning three or more open decks.

2.4 Bulkhead decks

2.4.1 The bulkhead deck is the uppermost deck up to which the transverse watertight bulkheads extend.

2.5 Control station

2.5.1 A control station is a dedicated space or an area of a service space which contains safety and control equpment such as:
- emergency electrical power plant or parts thereof
- control and monitoring equipment for machinery installations
- fire alarm equipment
- remote control of doors or dampers.

A control station shall be installed in a location not accessible to the public and supervised during hours of operation of the floating etablishment.

A control station shall be visible to staff and its controls and signaling shall remain accessible.

2.6 Fire reaction classes

2.6.1 Low flame-spread surface material

A low flame-spread means that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the standard fire test (see [2.18]).

Non-combustible materials are considered as low flame spread. However, due consideration will be given by the Society to the method of application and fixing.

2.6.2 Non-combustible material

Non-combustible material is a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C, this being determined in accordance with the standard fire test (see [2.18]). Any other material is a combustible material.

In general, products made only of glass, concrete, ceramic products, natural stone, masonry units, common metals and metal alloys are considered as being non-combustible and may be installed without testing and approval.

2.6.3 Non-ignitable

Non-ignitable material means a material which is not flammable, e.g.: composite , PVC, polyester.

2.6.4 Not readily ignitable material

Not readily ignitable material means a material which will not give rise to smoke or toxic and explosive hazards at elevated temperatures (see [2.18]).

2.6.5 Moderately ignitable

Moderately ignitable material means a material which will give moderately rise to smoke or toxic and explosive hazards at elevated temperatures (see [2.18]).

2.7 Fire resistance classes

2.7.1 "A" class divisions

"A" class divisions are those divisions formed by bulkheads and decks, ceilings or linings which comply with the following criteria:

a) they are constructed of steel or other equivalent material

b) they are suitably stiffened

c) they are insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180°C above the original temperature, within the time listed below:
   - class "A-60" .... 60 minutes
   - class "A-30" .... 30 minutes
   - class "A-0".................................... .... 0 minutes.

d) they are so constructed as to be able of preventing the passage of smoke and flame to the end of the one-hour standard fire test; and

e) the Society requires a test of a prototype bulkhead or deck in accordance with the Fire Test Procedures Code (see [2.8]) to ensure that it meets the above requirements for integrity and temperature rise.

The products indicated in Tab 2 may be installed without testing or approval.

2.7.2 "B" class division

"B" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which comply with the following criteria:

a) they are constructed of approved non-combustible materials and all materials used in the construction and erection of "B" class divisions are non-combustible, with the exception that surface materials may have low flame spread characteristics

b) they have an insulation value such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 225°C above the original temperature, within the time listed below:
   - class "B-15" .... 15 minutes
   - class "B-0" .... 0 minutes.

c) they are so constructed as to be able of preventing the passage of smoke and flame to the end of the first half hour of the standard fire test; and

d) the Society requires a test of a prototype division in accordance with the Fire Test Procedures Code (see [2.8]) to ensure that it meets the above requirements for integrity and temperature rise.

In order to be defined as B class, a metal division is to have plating thickness not less than 2 mm when constructed of steel.

Table 2 : Products installed without testing or approval

Classification	Product description
Class A-0 bulkhead	A steel bulkhead with dimensions not less than the minimum dimensions given below: • thickness of plating: 4 mm • stiffeners 60 x 60 x 5 mm spaced at 600 mm or structural equivalent
Class A-0 deck	A steel deck with dimensions not less than the minimum dimensions given below: • thickness of plating: 4 mm • stiffeners 95 x 65 x 7 mm spaced at 600 mm or structural equivalent

2.7.3 "E" class division

"E" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which comply with the following criteria, in accordance with the standard fire test adopted by the competent Authority (see [2.18]):

a) they are constructed of approved non-combustible materials and all materials used in the construction and erection of "E" class divisions are non-combustible

b) they are so constructed as to be able of preventing the passage of smoke and flame within the time listed below.
   - class "E-30" .... 30 minutes
   - class "E-15" .... 15 minutes.

2.7.4 "EI" class division

"EI" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which comply with the following criteria, in accordance with the standard fire test adopted by the competent Authoriry (see [2.18]):

a) They are constructed of approved non-combustible materials and all materials used in the construction and erection of "EI" class divisions are non-combustible.

b) They have an insulation value such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 180°C above the original temperature, within the time listed below:
   - class "EI-120" .... 120 minutes
   - class "EI-90" .... 90 minutes
   - class "EI-60" .... 60 minutes
   - class "EI-30" .... 30 minutes
   - class "EI-15" .... 15 minutes.

c) They are so constructed as to be able of preventing the passage of smoke and flame within the time listed under b) here above.

2.7.5 "REI" class division

"REI" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which, in addition to the criteria defined in [2.7.4] for "EI" class division, are so constructed as to be able of maintaining structural stability and adequate load bearing capacity within the time listed below, in accordance with the standard fire test adopted by the competent Authority (see [2.18]):

- class "REI-120" .... 120 minutes
- class "REI-90" .... 90 minutes
- class "REI-60" .... 60 minutes
- class "REI-30" .... 30 minutes
- class "REI-15" .... 15 minutes.

2.7.6 "R" class

"R" class structural elements are those structural items so constructed as to be able of maintaining structural stability and adequate load bearing capacity within the time listed below, in accordance with the standard fire test adopted by the competent Authoriry (see [2.18]):

- class "R-120" .... 120 minutes
- class "R-90" .... 90 minutes
- class "R-60" .... 60 minutes
- class "R-30" .... 30 minutes
- class "R-15" .... 15 minutes.

2.8 Fire Test Procedures Code

2.8.1 Fire Test Procedures Code means the "International Code for Application of Fire Test Procedures", as adopted by the Maritime Safety Committee of the IMO by Resolution MSC.61 (67), as may be amended by the IMO.

2.9 Galleys

2.9.1 Galley is a room with stove or a similar cooking appliance.

2.10 Lounge

2.10.1 Lounge is a room of an accommodation or a public area. Galleys are not regarded as lounges.

2.11 Machinery spaces

2.11.1 Machinery spaces are all spaces containing boilers, fuel oil units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

2.12 Main fire zones

2.12.1 Main fire zones are those sections into which the hull, superstructures and deckhouses are divided by A-class divisions, the mean length and width of which on any deck does not, in general, exceed 40 m.

2.13 Main structural element

2.13.1 A structural element is said to be "main", if its destruction has an effect on the structural stability.

2.14 Public areas

2.14.1 Public areas are areas on board intended for public and enclosed areas such as lounges, offices, shops, hairdressing salons, drying rooms, laundries, saunas, toilets, washrooms, passageways, connecting passages and stairs not encapsulated by walls.

2.15 Steel or other equivalent material

2.15.1 Steel or other equivalent material means any non-combustible material which, by itself or due to insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable exposure to the standard fire test (e.g., aluminium alloy with appropriate insulation).

2.16 Service spaces

2.16.1 Service spaces are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store-rooms, workshops other than those forming part of the machinery spaces, and similar spaces and trunks to such spaces.

2.17 Stairwell

2.17.1 Stairwell is the well of an internal staircase or of a lift.

2.18 Standard fire test

2.18.1 A standard fire test is a test in which specimens of the relevant bulkheads or decks are exposed in a test furnace to temperatures corresponding approximately to the standard time-temperature curve in accordance with the test method specified in the Fire Test Procedures Code (see [2.8]) or with the test method foreseen by the competent Authority.

2.19 Store room

2.19.1 Store room is a room for the storage of flammable liquids or a room with an area of over 4 m^2 for storing supplies.

SECTION 2 PREVENTION OF FIRE

1 Probability of ignition

1.1 Arrangements for fuel oil, lubrication oil and other flammable oils

1.1.1 Limitation in the use of oils as fuel

See Ch 1, Sec 1, [2.6].

1.1.2 Arrangements for fuel oil

For arrangement of fuel oil, see:

- Ch 1, Sec 3, [5]
- Ch 1, Sec 4, [6].

1.1.3 Arrangements for lubricating oil

For arrangement of lubricating oil, see:

- Ch 1, Sec 3, [5]
- Ch 1, Sec 4, [7].

1.1.4 Arrangements for other flammable oils

See Ch 1, Sec 4.

1.1.5 Sounding pipes

Sounding pipes of fuel tanks may not terminate in accommodation or public spaces.

1.2 Arrangements for gaseous fuel for domestic purposes

1.2.1 Where gaseous fuel is used for domestic purposes the arrangements for the storage, distribution and utilisation of the fuel shall be such that, having regard to the hazards of fire and explosion which the use of such fuel may entail, the safety of the unit and the persons on board is preserved.

See also Ch 1, Sec 5.

1.2.2 Storage of the gas bottles is to be located on the open deck or in a well ventilated space which opens only to the open deck.

1.3 Installation of boilers

1.3.1 Auxiliary and domestic boilers are to be arranged in such a way that other equipment is not endangered, even in the event of overheating. They must, in particular, be placed as far away as possible from fuel tanks and lubricating oil tanks. Oiltight trays are to be located below oil-fired boilers.

1.4 Insulation of hot surfaces

1.4.1 See Ch 1, Sec 1, [3.7].

1.5 Protective measures against explosion

1.5.1 For protective measures against explosion, see Ch 2, Sec 1, [4.4.5] to Ch 2, Sec 1, [4.4.12].

1.6 Miscellaneous items of ignition sources and ignitability

1.6.1 Electric heating appliances

No hooks or other devices on which clothing can be hung may be fitted above heaters without temperature limitation.

Where heaters are fitted in the bulkhead lining, a trough made of non-combustible material shall be mounted behind each heater in such a way as to prevent the accumulation of heat behind the lining.

1.6.2 Waste receptacles

In principle, all waste receptacles shall be constructed of non-combustible materials with no openings in the sides or bottom.

1.6.3 Insulation of surfaces against oil penetration

In spaces where penetration of oil products is possible, the surface of insulation shall be impervious to oil or oil vapours.

2 Fire growth potential

2.1 Control of flammable liquid supply

2.1.1 Fuel pumps, thermal oil pumps, fan motors and boiler fans are to be equipped with emergency stops. The outlet valves of fuel service tanks must be fitted with remotely operated shutoff devices. Emergency stops and remotely operated shutoff devices must be capable of being operated from permanently accessible open deck and protected from unauthorized use.

2.2 Control of air supply

2.2.1 Means must be provided for the airtight sealing of boiler and engine rooms. The air ducts to these spaces are to be fitted with closing appliances or equivalent devices made of non-combustible material which can be closed from the deck. Engine room skylights must also be able to be closed from outside.

2.3 Fire protection materials

2.3.1 Use of non-combustible materials

Insulating materials shall be non-combustible, except in supply spaces and refrigerated compartments of service spaces. Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings for cold service systems, need not be of non-combustible materials, but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame-spread characteristics.

Cold service means refrigeration systems and chilled water piping for air conditioning systems.

3 Smoke generation potential and toxicity

3.1 Paints, varnishes and other finishes

3.1.1 Paints, varnishes and other finishes used on exposed interior surfaces shall not be capable of producing excessive quantities of smoke and toxic products, this being determined, either according to the Fire Test Procedures Code, for units complying with Sec 1, [1.3.4] or according to other applicable recognised standards, in the case of units complying with Ch 3, Sec 1, [1.3.3].

3.1.2 The requirement [3.1.1] only applies to accommodation spaces, service spaces and control stations as well as stairway enclosures.

SECTION 3 DETECTION AND ALARM

1 General

1.1 Minimum number of detectors

1.1.1 Where a fixed fire detection and fire alarm system is required for the protection of spaces, at least one detector complying with the requirements given in [1.4] shall be installed in each such space.

1.2 Initial and periodical tests

1.2.1 The function of fixed fire detection and fire alarm systems required by the relevant Sections of this Chapter shall be tested under varying conditions of ventilation after installation.

1.2.2 The function of fixed fire detection and fire alarm systems shall be periodically tested to the satisfaction of the Society by means of equipment producing hot air at the appropriate temperature, or smoke or aerosol particles having the appropriate range of density or particle size, or other phenomena associated with incipient fires to which the detector is designed to respond.

1.3 General requirements

1.3.1 All day rooms normally accessible to public and staff as well as galleys and machinery spaces are to be monitored by a type tested, automatic fire detection and alarm system.

1.3.2 Detectors are to be grouped into separate sections, each of which shall not comprise more than one main fire zone or one watertight division and not more than two vertically adjacent decks.

If the fire detection system is designed for remote and individual identification of detectors, several decks in one main fire zone respectively one watertight division may be monitored by the same detector loop. The detector loop shall be so arranged, that in the event of a damage (wire break, short circuit, etc.) only a part of the loop becomes faulty.

Smoke detectors shall be used in passage ways, stairways and escape routes. Heat detectors shall be used in cabins in the accommodation area. Flame detectors shall only be used in addition to the other detectors.

1.3.3 The blowout of a fire and the area concerned are to be signalled automatically to the control station.

1.3.4 The requirements [1.3.2] and [1.3.3] are deemed to be met in the case of spaces protected by an automatic pressure water-spraying system designed in accordance with Ch 3, Sec 6, [6].

1.3.5 Manually operated call points are to be provided in addition to the automatic system:

- in passageways, enclosed stairways and at lifts
- in saloons, day rooms and dining rooms
- in machinery spaces, galleys and spaces with a similar fire hazard.

The manually operated call points shall be spaced not more than 10 m apart, however at least one call point shall be available in every watertight compartment.

1.3.6 The alarm set off by a manual call point shall be transmitted only to the rooms of the unit's staff and must be capable of being cancelled by the unit's staff. Manual call points are to be safeguarded against unintended operation.

1.4 Detector requirements

1.4.1 Detectors shall be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Detectors operated by other factors indicative of incipient fires may be considered by the Society provided that they are no less sensitive than such detectors. Flame detectors shall only be used in addition to smoke or heat detectors.

1.4.2 Smoke detectors required in all stairways, corridors and escape routes within accommodation spaces shall be certified to operate before the smoke density exceeds 12,5 per cent obscuration per metre, but not until the smoke density exceeds 2 per cent obscuration per metre. Smoke detectors to be installed in other spaces shall operate within sensitivity limits to the satisfaction of the Society having regard to the avoidance of detector insensitivity or oversensitivity.

1.4.3 Heat detectors shall be certified to operate before the temperature exceeds 78°C but not until the temperature exceeds 54°C, when the temperature is raised to those limits at a rate less than 1°C per minute. At higher rates of temperature rise, the heat detector shall operate within temperature limits to the satisfaction of the Society having regard to the avoidance of detector insensitivity or oversensitivity.

1.4.4 At the discretion of the Society, the permissible temperature of operation of heat detectors may be increased to 30°C above the maximum deckhead temperature in drying rooms and similar spaces of a normal high ambient temperature.

1.4.5 All detectors shall be of a type such that they can be tested for correct operation and restored to normal surveillance without the renewal of any component.

1.5 System control requirements

1.5.1 The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in the control station, the accommodation and the space to be protected.

2 Protection of machinery spaces

2.1 Installation

2.1.1 A fixed fire detection and fire alarm system shall be installed in any machinery space:

a) which is periodically unattended,

b) where the installation of automatic and remote control systems and equipment has been approved, or

c) where the machinery including sources of main electrical supply is provided with various degrees of automatic or remote control and is under supervision from a control station.

2.2 Design

2.2.1 The fire detection system required in [2.1] shall be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors are not permitted.

3 Protection of accommodation and service spaces

3.1 Smoke detectors in stairways, corridors and escape route

3.1.1 Smoke detectors shall be installed in all stairways, corridors and escape routes within accommodation spaces. Consideration shall be given to the installation of special purpose smoke detectors within ventilation ducting.

SECTION 4 CONTROL OF SMOKE SPREAD

1 General

1.1 General principle

1.1.1 The control of smoke spread is intended to maintain practicable the escapes for evacuation of the public, by extraction of smoke and combustion gases at the beginning of fire.

1.1.2 The smoke control can be achieved naturally or mechanically according to one of the following methods:

- by scanning the space to be maintained practicable, by fresh air intake and exhaust fumes
- by pressure difference between the volume to be protected and the fire area set on depression
- by combining the two methods hereabove.

1.1.3 While the public is on board, the smoke control shall be activated before triggering of the automatic water spray system, if fitted.

1.2 Application

1.2.1 The Articles of this Section are to be applied according to Tab 1, to the control of smoke spread on board various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1]	[2]
Not assigned	Yes		[3]
	No		[2]

1.2.2 The requirements of this Section are completed, as applicable, by the provisions specific to each type of floating establishment set out in Part D, Chapter 1.

2 Requirements for control of smoke spread

2.1 General requirements

2.1.1 Control stations, stairways and internal assembly stations shall be provided with a natural or a mechanical smoke extraction system.

Smoke extraction systems shall comply with [2.1.2] to [2.1.8]

2.1.2 They shall provide sufficient capacity and reliability.

2.1.3 They shall consider the operating conditions of floating establishments.

2.1.4 When the normal ventilation system is used for this purpose, it shall be so designed that its function will not be impaired by smoke.

2.1.5 They shall be provided with manual actuation.

2.1.6 It shall be possible to operate mechanical smoke extraction systems from a position permanently occupied by staff.

2.1.7 Natural smoke extraction systems shall be provided with an opening mechanism, operated either manually or by a power source inside the ventilator.

2.1.8 Manually operated actuators and opening mechanism shall be accessible from inside and outside of the protected space.

2.2 Ventilation systems

2.2.1 They shall be so designed as to prevent the spread of fire and smoke through the system.

2.2.2 The main inlets and outlets of all ventilation system shall be capable of being closed from outside the respective spaces in the event of a fire.

2.2.3 Ducts shall be constructed of steel or other equivalent non-combustible material.

2.2.4 Ducts exceeding 0,02 m^2 and passing through partitions complying with Ch 3, Sec 5, [2.2] shall be fitted with fire dampers. The fire dampers shall operate automatically but shall also be capable of being manually closed from both sides of the penetrated division.

2.2.5 Ventilation systems for galleys and machinery spaces shall be independent of the ventilation system serving other spaces.

2.2.6 Exhaust ducts are to be provided with suitably arranged hatches for inspection and cleaning. The hatches shall be located near the fire dampers.

2.2.7 All power ventilation shall be capable of being stopped from a central place outside the machinery space.

2.2.8 Galleys shall be fitted with ventilation systems and stoves with extractors.

Exhaust ducts from galley stoves shall comply with [2.2.1] to [2.2.7] and shall in addition be provided with a manually operated fire damper located in the lower end of the duct.

3 Alternative requirements for control of smoke spread

3.1 Protection of stairways

3.1.1 Mechanical smoke extraction is not permitted. The control of smoke spread shall be performed according to one of the following methods:

- by natural scanning, by fresh air intake and exhaust fumes
- by pressure difference with respect to adjacent areas set on depression.

3.1.2 Stairways desserving not more than two levels below evacuation deck (see Pt B, Ch 1, Sec 2, [1.11] for definition) need not be ventilated.

3.1.3 The smoke extraction of a non-enclosed staircase is not required if there is no requirement for smoke extraction in the volumes with which it communicates directly (levels, rooms, etc...).

3.2 Protection of corridors

3.2.1 The corridors shall be naturally or mechanically ventilated where:

- their length exceeds 30 m, or
- they desserve pressurised stairways, or
- they desserve spaces reserved to sleep, or
- they are located below the evacuation deck.

3.3 Protection of spaces accessible to public

3.3.1 The smoke extraction is mandatory in the spaces accessible to the public if their surface is equal to or greater than 300 m2 on the evacuation deck (see Pt B, Ch 1, Sec 2, [1.11] for definition) or on levels above, and 100 m2 on levels below the evacuation deck or premises without outward.

3.4 Ventilation and exhaust systems

3.4.1 They shall be so designed as to prevent the spread of fire and smoke through the system.

3.4.2 The main inlets and outlets of all ventilation system shall be capable of being closed from outside the respective spaces in the event of a fire.

3.4.3 Ducts shall be constructed of non-combustible material having a minimum fire resistance rating E15.

SECTION 5 CONTAINMENT OF FIRE

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Definitions

1.1.1 General

Spaces are classed according to encountered risks in:

- spaces of major fire hazard
- spaces of moderate fire hazard
- spaces of minor fire hazard.

1.1.2 Spaces of major fire hazard

Spaces of major fire hazard include spaces such as store rooms containing flamable liquids, control station, etc.

These spaces are not accessible to public.

1.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include spaces such as boiler room, generator room, galleys, service spaces, staff rooms reserved to sleep, etc.

These spaces are not accessible to public.

1.1.4 Spaces of minor fire hazard

Spaces of minor fire hazard are those not covered by [1.1.2] nor [1.1.3].

1.2 Classification of unit spaces

1.2.1 For the purpose of determining the appropriate fire integrity standard to be applied to boundaries between adjacent spaces, such spaces are classified according to their fire risk described in the following categories.

The title of each category is intended to be typical rather than restrictive.

a) Control stations

 spaces containing the communication equipment, spaces containing centralized fire alarm equipment, spaces containing centralized emergency public address system stations and equipment.

b) Staircases

 Interior stairways, lifts, enclosed emergency escape tanks. In this connection a stairway which is enclosed at one level only shall be regarded as part of the space from which it is not separated by a fire door.

c) Muster areas

d) Accommodation spaces of major fire hazard

 Accommodation spaces of major fire hazard are defined for each unit type in the relevant Section of Part D, Chapter 1.

e) Accommodation spaces of moderate fire hazard

 Accommodation spaces of moderate fire hazard are defined for each unit type in the relevant Section of Part D, Chapter 1.

f) Accommodation spaces of minor hazard

g) Machinery spaces

h) Galleys

i) Store rooms

 Miscellaneous stores, lockers having deck area exceeding 4 m^2, air conditioning rooms.

1.3 Application

1.3.1 The provisions of this Section apply to floating establishments according to Tab 1.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1]	[2]
Not assigned	Yes		[3]
	No		[2]

1.3.2 The requirements of this Section are completed, as applicable, by the provisions specific to each type of floating establishment set out in Part D, Chapter 1.

2 Fire containment

2.1 General requirements

2.1.1 The following areas shall be divided by vertical divisions complying with Ch 3, Sec 7, [2.2] and Ch 3, Sec 7, [2.3]:

a) public areas with a total surface area of more than 800 m^2

b) public areas in which there are bedrooms, at intervals of not more than 40 m.

The vertical divisions shall be smoke-tight under normal operating conditions and shall be continuous from deck to deck.

The doors shall be of self-closing type or shall be capable of remote release from the control station and individually from both sides of the door. Status of each fire door (open/ closed position) shall be indicated in the control station.

2.1.2 Galleys and control stations shall be separated from adjacent spaces by class A divisions. Machinery spaces are to be separated from accommodation areas by class A divisions. Doors fitted therein shall have the same fire resistance and shall be self-closing and reasonable gastight.

2.1.3 Hollows above ceilings, beneath floors and behind wall claddings shall be separated at intervals of not more than 14 m by non-combustible draught stops which, even in the event of fire, provide an effective fireproof seal.

2.2 Fire integrity of bulkheads and decks

2.2.1 The minimum fire integrity of all bulkheads and decks shall be as shown in Tab 2 and Tab 3.

2.2.2 The following requirements shall govern the application of the tables:

- Tab 2 shall apply to spaces without an installed sprinkler installation.
- Tab 3 shall apply to spaces in which a sprinkler installation in compliance with Ch 3, Sec 6, [6], is provided on both sides of bulkheads and deck.

2.3 Protection of stairways and lifts in accommodation and service spaces

2.3.1 Internal stairs and lifts shall be encapsulated at all levels by walls according to Tab 2 or Tab 3, with effective means of closure for all openings.

2.3.2 The following exceptions are admissible:

a) a staircase connecting only two decks does not need to be encapsulated, if on one of the decks the staircase is enclosed according to Tab 2 or Tab 3.

b) in a lounge, stairs need not be encapsulated if they are located entirely within the interior of this room, and

   - if this room extends over only two decks, or
   - if there is a pressurised sprinkler system 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.

2.4 Openings in class A and B divisions

2.4.1 The construction of all doors and door frames in class A and B divisions, with the means of securing them when closed, shall provide resistance to fire as well as to the passage of smoke (only for doors in class A divisions) and flames equivalent to that of the bulkheads in which the doors are fitted.

Such doors and door frames shall be of an approved type.

Watertight doors need not be insulated.

2.4.2 Fire doors in divisions required by Tab 2 and Tab 3 to machinery spaces, to galleys and to staircases shall be of self-closing type.

2.4.3 It shall be possible for each door to be opened and closed from each side of the bulkhead by one person only.

2.4.4 Self-closing doors, which are normally open, shall be capable of remote release from a continuously manned central control station and shall also be capable of release individually from a position at both sides of the door. Status of each fire door (open/ closed position) shall be indicated on the control station.

3 Fire containment alternative requirements

3.1 Application

3.1.1 The requirements of this Article apply, as an alternative to Article [2] to units complying with the criteria defined in Ch 3, Sec 1, [1.3.3].

3.2 Partitioning

3.2.1 Partitions are to be provided:

- between spaces without public access and with public access
- between spaces with public access
- between spaces with public access and escapes.

In general, the minimum fire resistance of these partitions is to comply with those given in Tab 4 and Tab 5, depending on the unit category and distance H.

3.2.2 Spaces with particular fire hazard

In addition to [3.2.1], the following applies for spaces of particular fire hazard:

a) Partitions between spaces of major fire hazard and public exits are to have airlock of rating EI 60 fitted with 2 doors E 30.

b) Partitions between spaces of moderate fire hazard and public exits are to have block-doors of rating EI 30 fitted with a closure.

c) Spaces of minor fire hazard not accessible to public are not subjected to particular requirements.

Table 2 : Fire integrity of bulkheads and decks in spaces without sprinkler installation

Spaces		(a)	(b)	(c)	(d)	(e)(f)(g)	(h)	(i)	(j)
Control stations	(a)	–	A0	A0	A0 / B15 **(1)**	A30	A60	A60	A60
Staircases	(b)		–	–	A0	A30	A60	A60	A60
Corridors	(c)			–	A0	A30	A60	A60	A60
Muster areas	(d)				–	A30 / B15 **(2)**	A60	A60	A60
Accommodation spaces	(e)(f)(g) **(5)**					– / B15 **(7)**	A60	A60	A60
Machinery spaces containing diesel engines **(6)**	(h)						A60 / A0 **(3)**	A60	A60
Galleys	(i)							A0	A60 / B15 **(4)**
Store rooms	(j)								–

(1) Divisions between control stations and inside embarkation areas shall be of type A0, in case of exterior embarkation areas is type B15 sufficient.
(2) Divisions between accommodation spaces and inside embarkation areas shall be of type A30, in case of exterior embarkation areas is type B15 sufficient.
(3) Divisions between machinery spaces shall be of type A60, otherwise of type A0.
(4) For divisions between galleys and refrigerating spaces or storage spaces for food is B15 sufficient.
(5) For all fire hazards.
(6) Other machinery spaces will be assigned a fire risk equivalent to that of accommodation spaces
(7) Divisions between spaces reserved to sleep, divisions between spaces reserved to sleep and corridors and vertical divisions separating accommodation spaces according to [2.1.1] shall comply with B15, for spaces fitted with pressurised sprinkler systems, B0.

Table 3 : Fire integrity of bulkheads and decks in spaces with sprinkler installation

Spaces		(a)	(b)	(c)	(d)	(e)(f)(g)	(h)	(i)	(j)
Control stations	(a)	–	A0	A0	A0 / B15 **(1)**	A0	A60	A60	A30
Staircases	(b)		–	–	A0	A0	A60	A30	A0
Corridors	(c)			–	A0	A0	A60	A30	A0
Muster areas	(d)				–	A30 / B15 **(2)**	A60	A60	A60
Accommodation spaces	(e)(f)(g) **(4)**					– / B0 **(6)**	A60	A30	A0
Machinery spaces containing diesel engines **(5)**	(h)						A60 / A0 **(3)**	A60	A60
Galleys	(i)							–	B15
Store rooms	(j)								–

(1) Divisions between control stations and inside embarkation areas shall be of type A0, in case of exterior embarkation areas is type B15 sufficient.
(2) Divisions between accommodation spaces and inside embarkation areas shall be of type A30, in case of exterior embarkation areas is type B15 sufficient.
(3) Divisions between machinery spaces shall be of type A60, otherwise of type A0.
(4) For all fire hazards.
(5) Other machinery spaces will be assigned a fire risk equivalent to that of accommodation spaces
(6) Divisions between spaces reserved to sleep, divisions between spaces reserved to sleep and corridors and vertical divisions separating accommodation spaces according to [2.1.1] shall comply with B15, for spaces fitted with pressurised sprinkler systems, B0.

Table 4 : Fire integrity of bulkheads and decks - H ≤ 8 m

Spaces		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Control stations	(a)	E15	EI120	EI120	EI120	EI120	EI120	EI120	EI120	EI120	EI120
Staircases	(b)		E15	EI30	EI30	EI120	EI30/EI60 **(1)**	E15/EI15 **(2)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**
Corridors	(c)			E15	EI30	EI120	EI30/EI60 **(1)**	E15/EI15 **(2)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**
Muster areas	(d)				E15	EI120	EI30/EI60 **(1)**	E15/EI15 **(2)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**
Accommodation spaces with major fire hazard	(e)					EI30	EI30	EI60	EI30/EI60 **(1)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**
Accommodation spaces with moderate fire hazard	(f)						EI30	EI60	EI30/EI60 **(1)**	EI30/EI60 **(1)**	EI30/EI60 **(1)**
Accommodation spaces with minor fire hazard	(g)							E15/EI15 **(2)**	EI30/EI60 **(3)**	EI30/EI60 **(3)**	EI30/EI60 **(3)**
Machinery spaces	(h)								E30	E15	E15
Galleys	(i)									E30	E15
Store rooms	(j)										E30

(1) EI30 for units of **Cat 2**, **Cat 3** and **Cat 4**, EI60 for units of **Cat 1**.
(2) E15, in the case of spaces not reserved to sleep, EI15 in the case of spaces reserved to sleep.
(3) EI60, in the case of spaces reserved to sleep on units of **Cat 1**, EI30, in all other cases.

Table 5 : Fire integrity of bulkheads and decks - 8 < H < 28 m

Spaces		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Control stations	(a)	E15	EI120	EI120	EI120	EI120	EI120	EI120	EI120	EI120	EI120
Staircases	(b)		E15	EI30	EI30	EI120	EI60	E15/EI15 **(1)**	EI60	EI60	EI60
Corridors	(c)			E15	EI30	EI120	EI60	E15/EI15 **(1)**	EI60	EI60	EI60
Muster areas	(d)				E15	EI120	EI60	E15/EI15 **(1)**	EI60	EI60	EI60
Accommodation spaces with major fire hazard	(e)					EI30	EI30	EI60	EI60	EI60	EI60
Accommodation spaces with moderate fire hazard	(f)						EI30	EI60	EI60	EI60	EI60
Accommodation spaces with minor fire hazard	(g)							E15/EI15 **(1)**	EI30/EI60 **(2)**	EI30/EI60 **(2)**	EI30/EI60 **(2)**
Machinery spaces	(h)								E30	E15	E15
Galleys	(i)									E30	E15
Store rooms	(j)										E30

(1) E15, in the case of spaces not reserved to sleep, EI15 in the case of spaces reserved to sleep.
(2) EI60, in the case of spaces reserved to sleep on units of **Cat 1**, EI30, in all other cases.

SECTION 6 FIRE FIGHTING SYSTEMS

Symbols

L : Rule length, in m, defined in Pt B, Ch 1, Sec 2, [1.1]

B : Breadth, in m, defined in Pt B, Ch 1, Sec 2, [1.2]

D : Depth, in m, defined in Pt B, Ch 1, Sec 2, [1.3]

L_{WL} : Length of waterline, in m, defined in Pt B, Ch 1, Sec 2, [1.6].

1 General

1.1 Application

1.1.1 This Section is applicable to fire fighting systems referred to in Part D, Chapter 1.

1.2 Use of toxic extinguishing media

1.2.1 The use of a fire extinguishing medium which, either by itself or under expected conditions of use gives off toxic gases, liquids or other substances in such quantitities as to endanger persons shall not be permitted.

1.3 Fire classification

1.3.1 Fire is classified according to NF S 60-100 (EN 2) in compliance with Tab 1.

Table 1 : Classification of fire

Fire class	Fire hazard	Extinguishing media
A	Solid combustible materials of organic nature (e.g. wood, coal, fibre materials)	Water, dry powder, foam
B	Flammable liquids (e.g. oils, tars, petrol)	Dry powder, foam, carbon dioxide
C	Gases (e.g. acetylene, propane)	Dry powder, carbon dioxide
D	Metals (e.g. aluminium, magnesium, sodium)	Special dry powder
F	Cooking auxiliaries (e.g. vegetable/animal oils and fats)	Suitable water-based or foam

2 Portable fire extinguishers

2.1 Type approval

2.1.1 Fire extinguishers must have been type approved, or approved by Authorities.

2.2 Engineering specifications

2.2.1 In the case of water and foam extinguishers, the charge shall not be less than 9,0 ℓ and not more than 13,5 ℓ.

2.2.2 The weight of the charge in dry powder extinguishers should be at least 6 kg. The maximum weight of a portable fire extinguisher ready for use shall not exceed 20 kg.

2.2.3 The extinguishing agent must be suitable at least for the class of fire most likely to occur in the space (or spaces) for which the fire extinguisher is intended. See Tab 1.

2.2.4 On units with electrical installations having an operating voltage greater than 50 V, the extinguishing agent must also be suitable for fighting fire in electrical equipment.

2.2.5 On units with oil-fired equipment, engine rooms and accommodation spaces are to be provided with dry powder extinguishers covering class A, B and C fires.

2.2.6 As extinguishing agent, fire extinguishers may contain neither CO_2 nor agents capable of emitting toxic gases in use.

2.2.7 Nevertheless, CO_2 extinguishers may be used for galleys and electrical installations. The content of these fire extinguishers shall be no more than 1 kg per 15 m^3 of the room in which they are made available for use.

2.2.8 Fire extinguishers with charges which are sensitive to frost or heat are to be mounted or protected in such a way that their effectiveness is guaranteed at all times.

2.2.9 Where fire extinguishers are mounted under cover, the covering must be properly marked.

2.3 Location

2.3.1 Portable fire extinguishers shall be located preferably in the escapes, in prominent places easily accessible. They may be protected provided that protective cupboards are clearly marked.

2.3.2 Portable fire extinguishers are to be judiciously distributed and appropriate to the particular fire risks.

3 Water supply systems

3.1 General

3.1.1 Fire pumps, fire mains, hydrants and hoses shall comply with the applicable requirements of this Article.

3.2 Fire mains and hydrants

3.2.1 General

Materials readily rendered ineffective by heat shall not be used for fire mains and hydrants unless adequately protected. The pipes and hydrants shall be so placed that the fire hoses may be easily coupled to them. The arrangement of pipes and hydrants shall be such as to avoid the possibility of freezing. Suitable drainage provisions shall be provided for fire main piping. Isolation valves shall be installed for all open deck fire main branches used for purposes other than fire fighting.

Deck-washing lines may be incorporated in the fire extinguishing system.

3.2.2 Number of hydrants

At least three hydrants are to be provided.

For units of **Cat 5**, at least two hydrants are to be provided.

3.3 Fire pumps

3.3.1 Pumps accepted as fire pumps

Combined ballast pumps, bilge pumps or other pumps exclusively pumping water may be accepted as fire pumps and shall be connected to the fire main by means of a non return valve.

3.3.2 Arrangements

Fire pumps are to be located beyond the end bulkheads (towards the central part).

Outboard connections for fire pumps are to be located as deep as possible. Pump suction must be safeguarded even in lightship condition.

3.4 Fire hoses and nozzles

3.4.1 Hoses must be able to be connected to the fire mains via fire hydrants and quick couplings.

At least two hoses with dual purpose nozzles are to be provided. These are to be stowed in hose boxes placed close to the hydrants.

Hose boxes are to be properly marked. Hose wrenches are to be provided in every hose box.

4 Fire hose stations

4.1 General

4.1.1 The hydraulic characteristics and installation of fire hose stations shall comply with the relevant standards.

4.2 Location

4.2.1 Where possible, the fire hose station shall be placed inside units, as close as possible and outside the premises to be protected.

4.2.2 The number of fire hose stations and choice of their locations shall be such that the entire surface of the premises can be effectively reached.

4.2.3 In premises with major fire hazard, any point on the surface shall be reached by at least two jets of water.

4.2.4 Cupboards, if provided, containing the fire hose stations shall be marked and not be locked.

4.3 Water supply

4.3.1 Where possible, the fire hose stations shall be supplied by the public network piping system.

A high feed tank or under pressure feed tank may exceptionally be admitted.

4.3.2 In all cases, the minimum operating pressure at which the flow is to be provided shall not be less than 2,5 bars.

Fire hose strations are to be equipped with a three-way valve manometer to allow the pressure control.

5 Dry main system

5.1 General

5.1.1 The dry main system shall comply with the relevant standards.

5.1.2 The hydrants shall be placed in staircases or in their access devices.

5.1.3 The dry main system shall be equipped with a drain and vent system.

5.2 Supply connections

5.2.1 Supply connections of the dry main system shall be located in areas readily accessible to firefighters, on the front of the nearest fire hydrants.

They should be reported and a sign shall indicate the staircase or its access device desserved.

Except in special cases, grouping of supply connections is prohibited.

5.2.2 The path between the supply connections of dry main system and fire hydrants shall not exceed 60 m in length.

6 Automatic pressure water spraying system (sprinkler system)

6.1 General

6.1.1 Where fitted, automatic pressure water spraying system shall comply with the provisions of this Article.

Alternative systems complying with recognized standards may, subject to approval, be accepted.

6.2 Pressure water tanks

6.2.1 Pressure water tanks are to be fitted with a safety valve, connected directly without valves to the water compartment, with a water level indicator that can be shut off and is protected against damage, and with a pressure gauge. Furthermore Ch 1, Sec 6, [1] is to be applied.

6.2.2 The volume of the pressure water tank shall be equivalent to at least twice the specified pump delivery per minute.

6.2.3 The tank shall contain a standing charge of fresh water equivalent to at least the specified volume delivered by the pump in one minute.

6.2.4 The tank is to be fitted with a connection to enable the entire system to be refilled with fresh water.

6.2.5 The pressure water tank is to be installed in a frost-proof space.

6.2.6 Means are to be provided for replenishing the air cushion in the pressure water tank.

6.3 Pressure water spraying pumps

6.3.1 The pressure pumps may only be used for supplying water to the pressure water-spraying systems.

6.3.2 In the event of a pressure drop in the system, the pump shall start up automatically before the fresh water charge in the pressure water tank has been exhausted. Suitable means of testing are to be provided.

6.3.3 The system shall be able to spray water at a rate of at least 5 ℓ/m^2 per minute over an area of at least 75 m^2.

For large rooms to be protected, one of the following provisions shall be complied with, depending on the fire risk encountered, at the Society's discretion:

- the rooms to be protected will be considered without sprinkler installation for determining the appropriate fire integrity standards to be applied to boundaries
- the sprinkler pump capacity will be determined on the basis of a minimum water rate of 5 ℓ/m^2 per minute, considering the area of the largest room, limited to 280 m^2.

6.3.4 The pump is to be provided with a direct suction connection at the unit's side. The shutoff device is to be secured in the open position. A suitable raw water filter is to be fitted, the mesh size of which is able to prevent coarse impurities from clogging the nozzles. The pump delivery is to be fitted with a test valve with connecting pipes, the cross-section of which is compatible with the pump capacity at the prescribed head.

6.4 Location

6.4.1 Pressure water tanks and pressure water pumps are to be located outside, and at a sufficient distance from, the rooms to be protected.

6.5 Water supply

6.5.1 The system shall be completely charged with fresh water when not in operation.

6.5.2 In addition to the water supply to the spraying equipment located outside the spaces to be protected, the system is also to be connected to the fire main via a screw-down non-return valve.

6.5.3 The equipment must be kept permanently under pressure and must be ready at all times for immediate, automatic operation. With the test valve at the alarm valve in the fully open position, the pressure at the level of the highest spray nozzles shall still be at least 1,75 bar.

6.6 Power supply

6.6.1 At least two mutually independent power sources shall be provided for supplying the pump and the automatic indicating and alarm systems. Each source shall be sufficient to power the equipment.

6.7 Piping, valves and fittings

6.7.1 Lines between suction connection, pressure water tank, shore connection and alarm valve are to comply with the dimensional requirements set out in Ch 1, Sec 3. Lines shall be effectively protected against corrosion.

6.7.2 Check valves are to be fitted to ensure that raw water cannot penetrate into the pressure water tank nor water for fire extinguishing be discharged overboard through pump suction lines.

6.7.3 Hose connections are to be provided at suitable points on the port and starboard sides for supplying the equipment with water from the shore. The connecting valves are to be secured against being opened unintentionally.

6.7.4 Each line leading to a section of the system is to be equipped with an alarm valve (see also [6.9]).

6.7.5 Shutoff devices located between the pump delivery and the alarm valves are to be secured in the open position.

6.8 Spray nozzles

6.8.1 The spray nozzles are to be grouped into sections.

A sprinkler section may extend only over one main fire section or one watertight compartment and may not include more than two vertically adjacent decks.

6.8.2 The spray nozzles are to be so arranged in the upper deck area that a water volume of not less than 5 $\ell/m^2 \cdot min$ is sprayed over the area to be protected.

6.8.3 Inside accommodation and service spaces the spray nozzles shall be activated within a temperature range from 68°C to 79°C. This does not apply to spaces such as drying rooms with higher temperatures. Here the triggering temperature may be up to 30 °C above the maximum temperature in the deck head area.

6.8.4 The nozzles are to be made of corrosion-resistant material. Nozzles of galvanized steel are not allowed.

6.9 Indicating and alarm systems

6.9.1 Every spray nozzle section is to be equipped with an alarm valve which, when a nozzle is opened, actuates a visual and audible alarm at one or more suitable positions, at least one of which must be permanently manned. In addition, each alarm valve is to be fitted with a pressure gauge and a test valve with an inner diameter corresponding to a spray nozzle.

6.9.2 At the positions mentioned here above, an automatic indicating device is to be mounted which identifies the actuated sprinkler section.

6.9.3 The electrical installation must be self-monitoring and must be capable of being tested separately for each section.

7 Fixed gas fire extinguishing systems

7.1 Application

7.1.1 Fixed gas fire extinguishing systems

Where required to be provided in machinery spaces containing internal combustion engines and oil fired boilers, fixed gas fire extinguishing systems shall comply with the requirements of this Article.

7.1.2 Fire extinguishing systems, inert gas systems, CO_2 systems etc. are to be installed after agreement with the Society in accordance with the Society's Rules.

7.2 Extinguishing agents

7.2.1 The following extinguishing agents are permitted:

a) CO2 (carbon dioxide)

b) HFC 227 ea (heptafluoropropane)

c) IG-541 (52% nitrogen, 40% argon, 8% carbon dioxide)

d) FK-5-1-12 (dodecafluoro-2-methylpentan-3-one).

7.2.2 Other extinguishing agents are permitted only if agreed by the Society.

7.2.3 The fixed fire-extinguishing systems according to [7.2.1] items b) to d) shall be type approved by the Society.

7.2.4 If other extinguishing agents will be permitted, these fixed fire-extinguishing systems are to be type approved by the Society as well.

7.3 Ventilation, air extraction

7.3.1 The combustion air required by the diesel engines should not come from spaces protected by permanently fixed fire-extinguishing systems. This requirement is not mandatory if the unit has two independent machinery spaces with a gastight separation.

7.3.2 All forced ventilation systems in the space to be protected shall be shut down automatically as soon as the fire-extinguishing system is activated.

7.3.3 All openings in the space to be protected which permit air to enter or gas to escape shall be fitted with devices enabling them to be closed quickly. It shall be clear whether they are open or closed.

7.3.4 Air escaping from the pressure-relief valves of the pressurised air tanks installed in the machinery spaces shall be led from the pressure-relief valves to the open air.

7.3.5 Overpressure or negative pressure caused by the diffusion of the extinguishing agent shall not destroy the constituent elements of the space to be protected. It shall be possible to ensure the safe equalization of pressure.

7.3.6 Protected spaces shall be provided with a means of extracting the extinguishing agent. If extraction devices are installed, it shall not be possible to start them up during extinguishing.

7.4 Piping system

7.4.1 The extinguishing agent shall be routed to 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 shall be made of steel. This shall not apply to the connecting nozzles of tanks and compensators provided that the materials used are fire resistant. Piping shall be protected against corrosion both internally and externally.

7.4.2 The discharge nozzles shall be so arranged as to ensure the regular diffusion of the extinguishing agent. In particular, the extinguishing agent must also be effective beneath the floor.

7.4.3 The necessary pipes for conveying fire-extinguishing medium into protected spaces shall be provided with control valves so marked as to indicate clearly the space to which the pipes are led. Suitable provision shall be made to prevent inadvertent release of the medium into the space. Where a cargo space fitted with a gas fire-extinguishing system is used as a passenger space the gas connection shall be blanked during such use.

The pipelines may pass through accommodation spaces providing they are of substantial thickness and their tightness is verified with a pressure test, after installation, at a pressure head not less than 5 MPa. In addition, pipelines passing through accommodation spaces are to be joined only by welding and are not to be fitted with drains or other openings within such spaces. The pipelines are not to pass through refrigerated spaces.

7.5 Triggering device

7.5.1 Automatically activated fire-extinguishing systems are not permitted.

7.5.2 It shall be possible to activate the fire-extinguishing system from outside the space to be protected.

7.5.3 Triggering devices shall 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 shall be supplied from two energy sources independent of each other. These energy sources shall be located outside the space to be protected. The control lines located in the space to be protected shall be so designed as to remain capable of operating in the event of a fire for a minimum of 30 minutes. 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 shall carry the "Fire-fighting 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

7.5.4 If the fire-extinguishing system is intended to protect several spaces, it shall comprise a separate and clearly marked triggering device for each space.

7.5.5 The instructions shall be posted alongside all triggering devices and shall be clearly visible and indelible. The instructions are to be at least in a language the staff can read and understand.

They shall include information concerning:

a) the activation of the fire-extinguishing system

b) the need to ensure that all persons have left the space to be protected

c) the correct behaviour of the staff in the event of activation or diffusion, in particular in respect of the possible presence of toxic substances

d) the correct behaviour of the staff in the event of the failure of the fire-extinguishing system to function properly.

7.5.6 The instructions shall 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 shall be shut down.

7.6 Alarm device

7.6.1 Permanently fixed fire-extinguishing systems shall be fitted with an audible and visual alarm device.

7.6.2 The alarm device shall be set off automatically as soon as the fire-extinguishing system is first activated. The alarm device shall function for an appropriate period of time before the extinguishing agent is released; it shall not be possible to turn it off.

7.6.3 Alarm signals shall 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 shall be possible to distinguish them clearly from all other sound and visual signals in the space to be protected.

7.6.4 Sound alarms shall also be clearly audible in adjoining spaces, with the communicating doors shut, and under operating conditions corresponding to the highest possible sound level.

7.6.5 If the alarm device is not intrinsically protected against short circuits, broken wires and drops in voltage, it shall be possible to monitor its operation.

7.6.6 A sign with the following text in red letters on a white ground shall 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!

7.7 Pressurized tanks, fittings and piping

7.7.1 Pressurized tanks, fittings and piping shall conform to the requirements of the competent authority.

7.7.2 Pressurized tanks shall be installed in accordance with the manufacturer's instructions.

7.7.3 Pressurized tanks, fittings and piping shall not be installed in the accommodation.

7.7.4 The temperature of cabinets and storage spaces for pressurized tanks shall not exceed 50°C.

7.7.5 Cabinets or storage spaces on deck shall be securely stowed and shall have vents so placed that in the event of a pressurized tank not being gastight, the escaping gas cannot penetrate into the unit. Direct connections with other spaces are not permitted.

7.8 Quantity of extinguishing agent

7.8.1 If the quantity of extinguishing agent is intended for more than one space, the quantity of extinguishing agent available does not need to be greater than the quantity required for the largest of the spaces thus protected.

7.9 Additional requirements applicable to specific fire extinguishing systems

7.9.1 In addition to the requirements contained in [7.1] to [7.8], fire-extinguishing systems using extinguishing agents listed in [7.1.1] shall conform to the provisions of NR217, Pt C, Ch 3, Sec 4, [4.9] to [4.12].

7.9.2 Tanks of CO_2 shall be placed in a gastight space or cabinet separated from other spaces. The doors of such storage spaces and cabinets shall open outwards; they shall be capable of being locked and shall carry on the outside the symbol "Warning: general danger", not less than 5 cm high and "CO_2" in the same colour and the same size.

SECTION 7 STRUCTURAL INTEGRITY

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Suitability for fire protection of materials and components

1.1.1 The suitability for fire protection of materials and components shall be established by an accredited test institution on the basis of appropriate test methods.

The test institution shall satisfy:

- Fire Test Procedures Code, see Ch 3, Sec 1, [2.8], or
- European standard EN ISO/IEC 17025: 2000 concerning the general requirements for the competence of testing and calibration laboratories, or
- Equivalent standard.

1.2 Application

1.2.1 The Articles of this Section are to be applied according to Tab 1, to the determination of the structural integrity on board various floating establishments.

Table 1 : Requirements applicable to various floating establishments

<table>
<tr><th rowspan="2">Autonomous</th><th rowspan="2">Compliance with Ch 3, Sec 1, [1.3.3]</th><th colspan="2">Applicable requirements</th></tr>
<tr><th>General</th><th>Specific</th></tr>
<tr><td>Assigned</td><td>Not applicable</td><td rowspan="3">[1]</td><td>[2]</td></tr>
<tr><td rowspan="2">Not assigned</td><td>Yes</td><td>[3]</td></tr>
<tr><td>No</td><td>[2]</td></tr>
</table>

1.2.2 The requirements of this Section are completed, as applicable, by the provisions specific to each type of floating establishment set out in Part D, Chapter 1.

2 Requirements for structural integrity

2.1 General

2.1.1 All insulation materials, bulkheads, linings, ceilings and draught stops shall be of at least approved non-combustible material.

Primary deck coverings and surface materials shall be of an approved type.

2.2 Material reaction to fire performance

2.2.1 Stairways

All stairways are to be of steel frame or other non-combustible construction.

2.2.2 Ventilation system

All parts of the system shall be made of non-combustible material, except that short ducts applied at the end of the ventilation device may be made of a material which has low-flame spread characteristics (see Ch 3, Sec 1, [2.6.1]).

2.2.3 Insulation materials

Insulation materials shall be non-combustible, except insulation of pipe fittings for cold service systems.

2.2.4 Products and materials of walls

a) Ceilings and linings in accommodation spaces including their substructures shall be of non-combustible material, unless the space is protected with a sprinkler installation.

b) The following surface materials shall have low flame spread characteristics:

- exposed surfaces in corridors and stairways and of bulkhead and ceiling linings in all spaces, except machinery spaces and store rooms, and
- surfaces and grounds in concealed and inaccessible spaces.

c) Paints, varnishings and other finishes used on exposed interior surfaces shall not be capable of producing excessive quantities of smoke and toxic gases (see Annex 1, Part 2 of Ch 3, Sec 1, [2.8]).

2.2.5 Fabrics, curtains and other hanging textiles

Fabrics, curtains and other hanging textiles (see Annex 1, Part 7 of Ch 3, Sec 1, [2.8]) as well as upholstered furniture (see Annex 1, Part 8 of Ch 3, Sec 1, [2.8]) and bedding components (see Annex 1, Part 9 of Ch 3, Sec 1, [2.8]) shall be fire retardant, unless the spaces are protected with a sprinkler installation.

2.2.6 Furniture and fittings

Furniture and fittings in public spaces, which are also assembly station, shall be made of non-combustible material, unless the public spaces are protected with a sprinkler installation.

2.3 Penetrations through class A and B divisions

2.3.1 Where class A and B divisions are penetrated for the passage of cables, pipes, trunks, ducts etc. or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements shall be made to ensure that the fire resistance is not impaired.

2.3.2 Bulkhead doors shall have the same fire resistance as the bulkheads in which they are fitted.

3 Alternative requirements for structural integrity

3.1 General

3.1.1 The requirements of this Article apply, as an alternative to Article [2], to units complying with the criteria defined in Ch 3, Sec 1, [1.3.3].

3.2 Material reaction to fire performance

3.2.1 Insulation materials

Insulation materials shall be non-combustible, except insulation of pipe fittings for cold service systems.

3.2.2 Products and materials of walls

a) The following structural elements shall be of non-ignitable material:
   - ceiling in corridors, stairways and all rooms
   - vertical walls of stairways.

b) The following structural elements shall be of not readily ignitable material:
   - vertical walls of corridors
   - vertical walls of rooms.

c) Floors in escapes and rooms shall be of moderately ignitable material.

3.2.3 Fabrics, curtains and other hanging textiles

Fabrics, curtains and other hanging textiles shall be:

- of non-ignitable materials in stairways
- of not readily ignitable materials in other escapes and rooms.

3.2.4 Furniture and fittings

Furniture and fittings in public spaces, which are also assembly station, shall be made of non-ignitable material.

3.3 Penetrations through class E, EI and REI divisions

3.3.1 General

Where fire resistant divisions are penetrated for the passage of cables, pipes, trunks, ducts etc. or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements shall be made to ensure that the fire resistance is not impaired.

3.3.2 Ducts passing through, originating or ending in a space of minor or moderate risks

a) Ducts passing through, originating or ending in a space of minor or moderate risks shall comply with the requirements listed in b) to d) here below.

   The fire resistance may be obtained:
   - either, by the ducts itself, if of sufficient fire resistance
   - or by shielding of the duct, or by fitting an automatic closing device in way of the penetration.

b) No fire resistance properties are required for:
   - fresh water ducts, regardless of their diameter
   - other ducts with nominal diameter less than or equal to 75 mm.

c) In way of penetration, ducts with diameter (d) 75 mm < d ≤ 315 mm are to be:
   - for vertical ducts: E30, e.g.
     - metallic ducts with melting point > 850°C
     - ducts with reinforced walls made of non-ignitable material (e.g. PVC) of diameter not exceeding 125 mm
   - for horizontal ducts: EI15.

d) Ducts not complying with c) here above or ducts with diameter d > 315 mm shall be:
   - either shielded with non-combustible material having a fire resistance rating EI of the crossed wall, without exceeding EI60

     Every two levels, vertical shielding shall be intercoastal in way of floors where non-combustible materials are to be fitted. Possible manhole covers in the shielding are to have a fire resistance rating of E30.
   - or fitted with an automatic closing device.

3.3.3 Ducts passing through, originating or ending in a space of major risks

Ducts of nominal diameter less than or equal to 125 mm shall comply with [3.3.2].

Ducts of nominal diameter exceeding 125 mm shall comply with the following:

- ducts passing through a space without desserving it shall have a fire resistance rating not less than that of the crossed wall
- ducts desserving a space shall comply with [3.3.2].

3.3.4 Garbage disposal and Lifts

a) Garbage disposal

   Garbage space is to be classed as space with major fire hazard.

   Ducts or shielding for garbage disposal shall:
   - be of non-combustible material
   - have a fire resistance rating EI60
   - have manhole covers of fire resistance rating E30.

b) Good lifts

Good lifts shall comply with the following:

- walls of the lift well or lift enclosure shall be of fire resistance rating EI60 (measured on each side)
- service manhole covers shall be of fire resistance E30, fitted with a door closer or with an automatic closing device
- where the unit does not comprise rooms reserved to sleep, spaces giving access to service manholes are to be classed as spaces with moderate fire hazard.

3.3.5 Ventilation and exhaust systems

- Ventilation ducts passing through a space without desserving it shall have, in way of the penetration, a fire resistance rating not less than that of the crossed wall.
- Exhaust ducts shall have a fire resistance rating not less than that of the crossed wall.

3.4 Fire resistance of main structural elements

3.4.1 The fire resistance of the main structural elements and floors shall be as shown in Tab 2, depending on its category and distance H to the evacuation deck.

According to the constructional materials chosen, additional protection may be required to be provided to meet these requirements. The additional protection may consist of:

- either, inserted products:
  - fire retardant paint or coating
  - sprayed materials with a plaster base, mineral fibers, etc.
- or applied facing plates.

Table 2 : Fire resistance of main structural elements and floors

H	Unit category	Unit item	Fire class
H ≤ 8	1	Str. element	R 60
		Floor	EI 60
	2, 3, 4, 5	Str. element	R 30
		Floor	EI 30
8 <H ≤ 28	1	Str. element	R 90
		Floor	EI 90
	2, 3, 4, 5	Str. element	R 60
		Floor	EI 60

SECTION 8 ESCAPE

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 Within the scope of this Section, an escape is any part of the unit allowing the evacuation of occupants: door, exit, corridor, stairways, hallway, etc.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2], [3]	[4]
Not assigned	Yes		[5]
	No		[4]

1.1.3 The requirements of this Section are completed, as applicable, by the provisions specific to each type of floating establishment set out in Part D, Chapter 1.

1.2 General requirements

1.2.1 Unless expressly provided otherwise in this Section, at least two widely separated and ready means of escape shall be provided from all spaces or groups of spaces.

1.2.2 Lifts shall not be considered as forming one of the means of escape as required by this Section.

1.2.3 The escape trunk shall have clear dimensions of at least 0,6 x 0,6 m.

1.2.4 Bulwark and guard rails

Parts of the deck intended for public, and which are not enclosed, shall comply with the following requirements:

a) they shall be surrounded by a fixed bulwark or guard rail in compliance with Pt B, Ch 7, Sec 1, [1]

b) openings and equipment for embarking or disembarking and also openings for loading or unloading shall be such that they can be secured.

2 Means of escape from machinery spaces

2.1 Escape arrangements

2.1.1 Means of escape from each machinery space shall comply with the provisions of [2.1.2] and [2.1.3].

2.1.2 Every engine room shall be provided with two means of escape as widely separated as possible. One of the means of escape shall be an emergency exit. If a skylight is permitted as an escape, it must be possible to open it from the inside.

2.1.3 In the case of machinery spaces of less than 35 m^2 one means of escape may be accepted.

3 Assembly stations

3.1 Units assigned additional service feature "Autonomous"

3.1.1 Assembly stations protected according to Ch 3, Sec 5, [2], are to be foreseen.

3.2 Units not assigned additional service feature "Autonomous"

3.2.1 Units complying with criteria in Sec 1, [1.3.3]

Evacuation is the rule for persons capable of moving on their own.

Where the greatest vertical distance of the low floor of the highest superstructure tier accessible to public, to the shore ground exceeds 28 m, assembly stations protected according to Ch 3, Sec 5, [3], are to be foreseen at each level.

3.2.2 Units not complying with criteria in Sec 1, [1.3.3]

Assembly stations protected according to Ch 3, Sec 5, [2], are to be foreseen.

4 Means of escape from control stations, accommodation spaces and service spaces

4.1 General requirements

4.1.1 Stairways and ladders shall be so arranged as to provide ready means of escape from accommodation spaces and from spaces in which the staff is normally employed, other than machinery spaces.

4.1.2 All stairways in accommodation and service spaces and control stations shall be of steel frame construction except where the Society allows the use of other equivalent material.

4.1.3 Doors in escape routes shall, in general, open in way of the direction of escape, except that:

a) individual cabin doors may open into the cabins in order to avoid injury to persons in the corridor when the door is opened, and

b) doors in vertical emergency escape trunks may open out of the trunk in order to permit the trunk to be used both for escape and for access.

4.2 Escape arrangements

4.2.1 Below the lowest open deck the main means of escape shall be a stairway and the second escape may be a trunk or a stairway.

4.2.2 Above the lowest open deck the means of escape shall be stairways or doors to an open deck or a combination thereof.

4.2.3 Exceptionally the Society may dispense with one of the means of escape, for staff spaces that are entered only occasionally, if the required escape route is independent of watertight doors.

4.3 Means of escape

4.3.1 The number and width of the exits of public rooms shall comply with the following requirements:

a) Rooms or group of rooms designed or arranged for 30 or more persons or including berths for 12 or more persons shall have at least two exits. On board units without berths, rooms and groups of rooms that have only one exit shall have at least one emergency exit.

b) If rooms are located below the bulkhead deck, one of the exits can be a watertight bulkhead door leading into an adjacent compartment from which the upper deck can be reached directly. The other exit shall lead directly or, if permitted in accordance with (a), as an emergency exit into the open air, or to the bulkhead deck. This requirement does not apply to individual bedrooms.

c) Exits according to (a) and (b) shall be suitably arranged and shall have a clear width of at least 0,80 m and also a clear height of at least 2,00 m. For doors of public bedrooms and other small rooms, the clear width can be reduced to 0,70 m.

d) In the case of rooms or groups of rooms intended for more than 80 persons, the sum of the widths of all exits intended for public and which shall be used by them in an emergency shall be at least 0,01 m per person.

e) If the total width of the exits is determined by the number of persons, the width of each exit shall be at least 0,005 m per person.

f) Emergency exits shall have a shortest side at least 0,60 m long or a minimum diameter of 0,70 m. They shall open in the direction of escape and be marked on both sides.

4.4 Doors of public rooms

4.4.1 Doors of public rooms shall comply with the following requirements:

a) with the exception of doors leading to connecting corridors, they shall be capable of being opened outwards or be constructed as sliding doors

b) Bedroom doors shall be made in such a way that they can also be unlocked from the outside at any time.

c) Powered doors shall open easily in the event of failure of the power supply to this mechanism.

4.5 Stairs

4.5.1 Stairs and their landings in the public areas shall comply with the following requirements:

a) they shall be constructed in accordance with recognized standards (EN 13056:2000 or equivalent standards)

b) they shall have a clear width of at least 0,80 m or, if they lead to connecting corridors or areas used by more than 80 persons, at least 0,01 m per person

c) they shall have a clear width of at least 1,00 m if they provide the only means of access to a room intended for public

d) Where there is not at least one staircase on each side of the unit in the same room, they shall lie in the safe area.

4.6 Escape routes

4.6.1 Escape routes shall comply with the following requirements:

a) Stairways, exits and emergency exits shall be so disposed that, in the event of a fire in any given area, the other areas may be evacuated safely.

b) The escape routes shall lead by the shortest route to assembly stations.

c) Escape routes shall not lead through machinery spaces or galleys. This requirement item does not apply to units of **Cat 5**, as long as a second escape route is available.

d) There shall be no rungs, ladders or the like installed at any point along the escape routes.

e) Doors to escape routes shall be constructed in such a way as not to reduce the minimum width of the escape route.

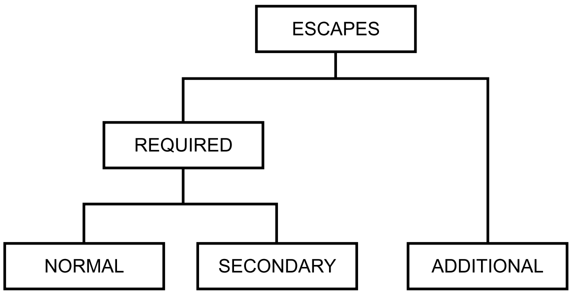
f) Escape routes and emergency exits shall be clearly signed. The signs shall be lit by the emergency lighting system.

5 Means of escape from control stations, accommodation spaces and service spaces - Alternative requirements

5.1 Definitions

5.1.1 The definitions given in this Sub-article are summarised in Fig 1.

Figure 1 : Escapes



5.1.2 Normal escape

A normal escape is an escape included in the minimum required number of escapes, complying with the provisions of [5.3].

5.1.3 Secondary escape

A secondary escape is an escape imposed exceptionally when normal escapes may not be judiciously distributed in the room, level, compartment or floating establishment.

5.1.4 Emergency escape

An emergency escape is an escape that, for operational reasons, is not in constant use by the public.

5.1.5 Additional escape

An additional escape is an escape in excess of escapes defined in [5.1.2] to [5.1.4].

5.1.6 Protected escape

A protected escape is an escape in which the public is protected from the flames and smoke.

5.2 Arrangement of escapes

5.2.1 Escapes shall allow a quick and safe evacuation of the unit.

5.2.2 Escapes are to be inter-connected by corridors with a minimum width of 1,40 m:

- On evacuation deck, stairways to exits, and exits between them
- On levels under/above evacuation deck, stairways between them.

However, the width of these corridors may be reduced to 0,90 m when connected escapes offer only a free passage of 0,90 m.

5.2.3 Distribution of exits

The required exits of the unit, levels, compartments or rooms shall be carefully distributed in order to ensure the rapid evacuation of public and avoid multiple exits to be subjected together to the effects of the disaster.

5.2.4 Maximum distance

The maximum distance to be covered by the public on the evacuation deck, measured along the axis of circulation, from any point of a space to an exit to the outside or a protected escape leading to the outside shall not exceed:

- 50 m, in the case of multiple exits
- 30 m, otherwise.

5.3 Design of escapes

5.3.1 Each escape shall have a minimum width proportional to the intended total number of persons, n_P, having to follow it.

5.3.2 Calculation of escapes

Levels, rooms or compartments shall be desserved under the conditions defined in Tab 2, depending on the number, n_P, of persons who may be admitted.

Table 2 : Calculation of escapes

Number of persons, n_P	Number of escapes	Width of escapes, in m
$n_P < 20$	1	0,90
$20 \le n_P \le 50$	• Evacuation deck: 2 • Under evacuation deck: 2	1 x 0,90 + 1 secondary escape
	Above evacuation deck: • H ≤ 8 m: 1 stairway • H > 8 m: 1 stairway + 1 secondary escape	• 1 x 0,90 • 1 x 0,90 + 1 secondary escape
$50 < n_P \le 100$	2	• 2 x 0,90 or • 1 x 1,40 + 1 secondary escape
$100 < n_P \le 500$	2	$0{,}60.x_2$
$n_P > 500$	$x_1 + 1$	$0{,}60.(x_2 + 1)$

x_1 : Parameter defined as follows:
$x_1 = n_P/500$, if n is a multiple of 500
$x_1 = n_P/500 + 1$, otherwise

x_2 : Parameter defined as follows:
$x_2 = n_P/100$, if n is a multiple of 100
$x_2 = n_P/100 + 1$, otherwise

5.4 Secondary escapes

5.4.1 Secondary escapes may consist of exits, stairways or passageways having a minimum width of 0,60 m.

5.5 Additional escapes

5.5.1 Additional escapes may be provided at the initiative of the Owner.

RULES FOR THE CLASSIFICATION OF FLOATING ESTABLISHMENTS

Part D
Additional Requirements for Notations

Chapters **1 2**

September 2012

Part D
Additional Requirements for Notations

Chapter 1
ADDITIONAL SERVICE FEATURES

SECTION 1 J TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments equipped with reception facilities for senior and persons with reduced mobility.

1.1.2 Definition

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

1.1.3 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [3]	[4.1]
Not assigned	Yes		[2], [4.2], [5]
	No		[4.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as the sum of the following:

- the maximum number of residents and effective staff
- one person to three residents for visitors.

The numbers above should be increased by that of the rooms or areas that can accommodate people other than the visitors.

1.3 Categories of units

1.3.1 J type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 100.

1.4 Safety principles

1.4.1 Given the specificity of J-type units and the specific conditions of their operation, on the one hand, the inability or difficulty of part of the public to evacuate or be evacuated quickly, on the other hand, the security of the entire facility to meet the provisions of these Rule notes, especially at the beginning of the fire, is the horizontal transfer of them to a contiguous area adequately protected.

1.4.2 The vertical evacuation of these persons may be considered only in cases of extreme necessity.

1.4.3 The vertical evacuation remains the rule for persons capable of moving on their own.

2 Control of smoke spread

2.1 General

2.1.1 The smoke control devices of spaces, halls, compartments and corridors are to be necessarily enslaved to automatic fire detection system.

2.2 Smoke extraction in stairways

2.2.1 Stairways are to be pressurised with respect to surrounding volumes or naturally ventilated. Mechanical extraction is prohibited.

2.3 Smoke extraction in corridors

2.3.1 The corridors serving the levels open to the public, regardless of their length, shall be mechanically ventilated, with the exception of corridors of units with at most one level above the evacuation deck and halls that can be naturally ventilated.

3 Containment of fire

3.1 Accommodation spaces with particular fire hazard

3.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [3.1.2] and [3.1.3].

3.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:

- storage of oxygen cylinders with a total water capacity greater than 200 liters
- store room whose volume exceeds 250 m^3.

3.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- laundry rooms, supply rooms, luggage storage
- storage of oxygen cylinders or flammable liquids (Q> 10 liters)
- waste rooms
- maintenance room (painting, carpentry), etc.

4 Fire fighting

4.1 General requirements

4.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

4.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for:

   - each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
   - each group of 10 bedrooms, or part thereof.

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

4.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

4.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

4.2 Alternative requirements

4.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [4.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

4.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

4.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

5 Escape

5.1 Corridors

5.1.1 The corridors of levels open to the public shall have a minimum width of 1,40 m.

5.2 Maximum distance

5.2.1 The maximum distance measured along the axis of circulation, from any point of a space to the stairway access shall not exceed 40 m or 30 m in the case of a space forming part of a cul-de-sac.

5.3 Stairways

5.3.1 Each level open to the public is to be served by at least one stairway 1,40 m wide.

5.3.2 The width of the secondary stairways shall not be less than 0,90 m.

5.3.3 The implementation of stairways is to be such that the public can, at every level, access stairways without transit through the area subjected to fire.

SECTION 2 L TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as cinemas, theatre, meeting rooms or as multipurpose rooms for similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as follows:

a) Hearing rooms, conference rooms, meeting rooms, cinemas, hall, theatre:
   - number of people sitting on seats or numbered bench seats
   - number of people sitting on not numbered bench seats, on the basis of a person per 0, 50 linear meter
   - number of people attending an event without having seats, on the basis of 3 persons per m^2
   - number of people normally parked in walkways and in the queue on the basis of 5 persons per linear meter.

b) Cabarets

   four persons per 3 m^2 of hall surface net of musician furniture and capital facilities other than tables and chairs

c) Multipurpose rooms

   one person per m^2 of total area of the room

d) Meeting rooms

   one person per m^2 of total area of the room

e) Multimedia rooms

   one person per 2 m^2 of total area of the room.

1.3 Categories of units

1.3.1 L type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to:

a) 200, for:
   - hearing rooms
   - conference rooms
   - meeting rooms
   - multimedia rooms.

b) 50, for:
   - cinemas
   - theatre
   - cabarets
   - multipurpose rooms.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:
- block-scenes
- sets and accessories stores
- equipment stores
- workshops for production, cleaning and maintenance of costumes
- manufacturing facilities of sets
- barbers and cobblers premises
- maintenance, repair and decoration shops
- archive premises
- photocopying facilities
- infotheques (archive of film, video, etc.).

2.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- the dressing rooms, individual and collective
- rehearsal
- homes and meeting rooms (for professional use and not accessible to the public)
- a unique premise under 50 m^3 use to store the equipment.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, for units of other categories.
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 3 M TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as shops, shopping malls or similar activities.

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.3 Categories of units

1.3.1 M type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces not accessible to public with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of minor fire hazard

Spaces of minor fire hazard include:

- administrative and social spaces
- spaces dedicated to services directly related to the sale, except packing spaces.

2.1.3 Spaces of major fire hazard

Spaces of major fire hazard include:

- spaces for storage and handling of packaging materials and packaging deposits
- reserve spaces.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed
f) at each entrance to spaces in which materials presenting a fire hazard are stored
g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers
c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include the following, depending on the size and encountered fire risks:

a) Units exceeding 3000 m^2, with the exception of sales areas in the open:
   - Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories.
   - Portable fire extinguishers appropriate to the particular risks.
   - Fire hose stations, complying with Pt C, Ch 3, Sec 6, [5], number and locations of which are to be determined so that the entire surface of the premises can be effectively achieved by two jts of water.
   - Automatic pressure water spraying systems complying with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

b) Units of **Cat 1, Cat 2** and **Cat 3** not exceeding 3000 m^2:
   - Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher.
   - Portable fire extinguishers appropriate to the particular risks.
   - A water supply system complying with [3.1.1].

c) Units of **Cat 4**:
   - Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher.
   - Portable fire extinguishers appropriate to the particular risks.

d) Units of **Cat 5**:
   - Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed with a minimum of one extinguisher per 300 m^2 and per level.
   - Portable fire extinguishers appropriate to the particular risks.

SECTION 4 N TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as restaurants, bars or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as follows, net of surface of platforms for musicians and capital facilities other than tables and chairs:

a) Seated dining areas: 1 persons per m^2

b) Standing dining areas: 2 persons per m^2

c) Queue: 3 persons per m^2.

1.3 Categories of units

1.3.1 N type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, all accommodation spaces may be considered as of minor fire hazard.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 5 O TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as hotels or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [3]	[4.1]
Not assigned	Yes		[2], [4.2], [5]
	No		[4.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.3 Categories of units

1.3.1 O type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 100.

2 Control of smoke spread

2.1 General

2.1.1 The smoke control devices of corridors desserving spaces reserved to sleep are to be necessarily enslaved to automatic fire detection system.

2.2 Smoke extraction in stairways

2.2.1 Stairways are to be pressurised with respect to surrounding volumes or naturally ventilated. Mechanical extraction is prohibited.

2.3 Smoke extraction in premises accessible to public

2.3.1 The smoke extraction is mandatory in the premises accessible to the public if their surface is equal to or greater than 300 m^2 on the evacuation deck or on levels above, and 100 m^2 on levels below the evacuation deck or premises without outward.

2.4 Smoke extraction in corridors

2.4.1 The corridors serving the levels open to the public shall be naturally or mechanically ventilated if they desserve spaces reserved to sleep where:

- their length exceeds 10 m, and
- desserved sleep spaces are located more than on level above the evacuation deck.

3 Containment of fire

3.1 Accommodation spaces with particular fire hazard

3.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [3.1.2] and [3.1.3].

3.1.2 Spaces of major fire hazard

Spaces of major fire hazard include workshops for maintenance and repair.

3.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- Galleys, offices, reserve spaces
- Laundry and luggage spaces.

4 Fire fighting

4.1 General requirements

4.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

4.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for:

- each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
- each group of 10 bedrooms, or part thereof.

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

4.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

4.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

4.2 Alternative requirements

4.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [4.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

4.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

4.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

5 Escape

5.1 Corridors

5.1.1 The corridors joining stairways, stairways to exits and exits shall have a minimum width of 1,40 m.

5.2 Maximum distance

5.2.1 The maximum distance measured along the axis of circulation, from any point of a space to the stairway access shall not exceed 40 m.

SECTION 6 P TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as dance halls, play rooms or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [3]	[4.1]
Not assigned	Yes		[2], [4.2]
	No		[4.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as follows:

a) In general

4 persons per 3 m^2 of the room surface, net of surface of platforms for musicians and capital facilities other than tables and chairs

b) Rooms reserved exclusively to the bar billiards other than electric or electronic

4 persons per bar billiards, increased by places reserved to public:

- either on chairs, benches or stands
- or in an area reserved for the consumption of beverages or food (Annex of N type).

1.3 Categories of units

1.3.1 P type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 120.

2 Control of smoke spread

2.1 Smoke extraction in stairways

2.1.1 Stairways are to be pressurised with respect to surrounding volumes or naturally ventilated. Mechanical extraction is prohibited.

2.2 Smoke extraction in premises accessible to public

2.2.1 The smoke extraction is mandatory in the premises accessible to the public if their surface is equal to or greater than 300 m^2 on the evacuation deck or on levels above, and 100 m^2 on levels below the evacuation deck or premises without outward.

2.3 Smoke extraction in corridors

2.3.1 The corridors serving the levels open to the public shall be naturally or mechanically ventilated where:

- their length exceeds 5 m, or
- they desserve pressurised stairways, or
- they desserve spaces reserved to sleep, or
- they are located below the evacuation deck.

3 Containment of fire

3.1 Accommodation spaces with particular fire hazard

3.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [3.1.2] and [3.1.3].

3.1.2 Spaces of major fire hazard

Spaces of major fire hazard include the storage of media music.

3.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- reserve store
- offices.

4 Fire fighting

4.1 General requirements

4.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

4.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

4.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

4.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

4.2 Alternative requirements

4.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [4.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

4.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

4.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 7 R TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as training centers, vacation centers, day care centers or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [3]	[4.1]
Not assigned	Yes		[2], [4.2]
	No		[4.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.3 Categories of units

1.3.1 R type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to:

- 100, for nursery school, day nursery
- 200, for other floating establishments
- 30, for units with rooms reserved to sleep.

2 Control of smoke spread

2.1 Smoke extraction in stairways

2.1.1 Stairways are to be pressurised with respect to surrounding volumes or naturally ventilated. Mechanical extraction is prohibited.

2.2 Smoke extraction in premises accessible to public

2.2.1 The smoke extraction is mandatory in the premises accessible to the public if their surface is equal to or greater than 300 m^2 on the evacuation deck or on levels above, and 100 m^2 on levels below the evacuation deck or premises without outward.

2.3 Smoke extraction in corridors

2.3.1 The corridors serving the levels open to the public, regardless of their length, shall be naturally or mechanically ventilated.

3 Containment of fire

3.1 Accommodation spaces with particular fire hazard

3.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in Tab 2.

Spaces for preparation and collections are classified as minor fire hazard.

3.1.2 All accommodation spaces containing flammable liquids shall comply with the following:

- they shall have a permanent high and low ventilation appropriately distributed
- the sectional area of upper and lower vents must be at least equal respectively to 1/100 of the surface of the premises, with a minimum of 0,1 m^2 per mouth.

4 Fire fighting

4.1 General requirements

4.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

4.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station
b) close to each entrance from the deck to accommodation areas
c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas
d) at each entrance to machinery spaces
e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed
f) at each entrance to spaces in which materials presenting a fire hazard are stored
g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for:
   - each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
   - each group of 10 bedrooms, or part thereof.
b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.
c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

4.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

4.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

4.2 Alternative requirements

4.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [4.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

4.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

4.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

Table 2 : Spaces with particular fire hazard

Accommodation space	Particular fire hazard	
	Moderate	Major
Storage of flamable liquids for teaching and research	$20 < C \leq 300$	$300 < C < 1000$
Storage of dangerous substances for teaching and research, other than flamable liquids	x	
Other spaces	• stores of furniture reserve • stores of cleaning products' reserve • stores of school supplies • archives • storage areas of combustible materials located in the workshops	

Note 1: According to classification of liquids flamability:
A : Relative capacity of extremely flammable liquids, in ℓ
B : Relative capacity of easily flammable liquids, in ℓ
C : Equivalent capacity, in ℓ
$C = 10A + B$

SECTION 8 S TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as libraries, documentation centers or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.3 Categories of units

1.3.1 S type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:

- Bookbinding and restoration workshops
- Documents conservation stores
- Archives
- Spaces for packing and handling of waste
- Spaces for storage and handling of hazardous substances.

2.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- Close reserves of a volume less than 300 m^3.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 9 T TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as showroom or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as follows:

a) Showrooms, fairs, temporary exhibitions

one person per m^2 of the total surface accessible to public

b) Permanent showrooms

one person per 9 m^2 of the total surface accessible to public.

1.3 Categories of units

1.3.1 T type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:

- Reserves and store rooms of a volume greater than 500 m^3
- Spaces for receipt of materials and goods.

2.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- Reserves and store rooms of a volume not exceeding 500 m^3
- Maintenance and repair workshops.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station
b) close to each entrance from the deck to accommodation areas
c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas
d) at each entrance to machinery spaces
e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed
f) at each entrance to spaces in which materials presenting a fire hazard are stored
g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.
c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 10 U TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as hospitals, dispensaries or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [3]	[4.1]
Not assigned	Yes		[2], [4.2], [5]
	No		[4.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be defined by the designer.

1.2.2 Where the number of persons admitted together on board is not known, it may be estimated as the sum of the following:

- one person per berth
- one person per 3 berths, for staff
- one person per berth, for visitors
- eight persons, public and staff, per consultation post.

1.2.3 The number of persons determined according to [1.2.2] shall be increased by the number of persons in other eventual rooms or areas that can accommodate people. The list of such rooms or areas is to be drawn by the designer and the number of persons will be determined in relation with the space function.

1.3 Categories of units

1.3.1 U type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to:

- 100, for units without rooms reserved to sleep
- 20, for units with rooms reserved to sleep.

2 Control of smoke spread

2.1 General

2.1.1 On levels with rooms reserved to sleep, the smoke control devices of corridors are to be necessarily enslaved to automatic fire detection system.

2.2 Smoke extraction in stairways

2.2.1 Stairways are to be pressurised with respect to surrounding volumes or naturally ventilated. Mechanical extraction is prohibited.

2.3 Smoke extraction in premises accessible to public

2.3.1 The smoke extraction is mandatory in the premises accessible to the public if their surface is equal to or greater than 300 m^2 on the evacuation deck or on levels above, and 100 m^2 on levels below the evacuation deck or premises without outward.

2.4 Smoke extraction in corridors

2.4.1 The corridors serving the levels open to the public shall be naturally or mechanically ventilated where:

- their length exceeds 30 m, or
- they desserve pressurised stairways, or
- they are located below the evacuation deck.

2.4.2 The corridors serving the levels with rooms reserved to sleep and halls used for the public evacuation shall be mechanically ventilated.

3 Containment of fire

3.1 Accommodation spaces with particular fire hazard

3.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in Tab 2.

Food assembly spaces and preparation heating spaces using only electrical energy are classified as minor fire hazard.

Table 2 : Spaces with particular fire hazard

Accommodation space	Particular fire hazard	
	Moderate	Major
Functional spaces		
Galleys	Power of heating appliances > 20 kW or use of open fryer	
Technical workshops	If hot spot or 5 < V < 100 or 10 < Q < 200	Joinery or 200 < Q < 400 or V > 100
Closed spaces for ambulance access	x	
Sterilization Ethylene oxide unit	x	
Storage of medical gases	50 < CE < 200	CE > 200
Spaces where flammable liquids are used or stored		
Laboratories	10 < Q < 400 (with a maximum of 200 per space)	Q > 400
Reserves	10 < Q < 100	
Care unit	3 < Q < 10 (per unit)	
Spaces where flammable articles are stored		
Archives	50 < V < 100 **(1)**	V > 100 **(1)**
waste spaces other reserves Pharmacy	5 < V < 100 **(1)**	V > 100 **(1)**

Note 1:
Q : Quantity of flammable liquids, in ℓ
V : Space volume, in m^3
CE : Equivalent water capacity, in ℓ
(1) Volume to be doubled in the case of spaces without berths

3.1.2 All accommodation spaces containing flammable liquids shall comply with the following:

- they shall have a permanent high and low ventilation appropriately distributed
- the sectional area of upper and lower vents must be at least equal respectively to 1/100 of the surface of the premises, with a minimum of 0,1 m^2 per mouth.

4 Fire fighting

4.1 General requirements

4.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

4.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas
d) at each entrance to machinery spaces
e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed
f) at each entrance to spaces in which materials presenting a fire hazard are stored
g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for:
   - each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
   - each group of 10 bedrooms, or part thereof.
b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.
c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

4.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

4.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

4.2 Alternative requirements

4.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [4.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

4.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

4.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

5 Escape

5.1 Corrirors

5.1.1 The corridors joining stairways, stairways to exits and exits shall have a minimum width of 1,40 m.

5.2 Room doors

5.2.1 Room doors shall have a minimum width of 1,10 m.

5.3 Maximum distance

5.3.1 The maximum distance measured along the axis of circulation, from any point of a space to the stairway access shall not exceed 40 m or 30 m in the case of a space forming part of a cul-de-sac.

SECTION 11 V TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended for worship or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1]	[2.1]
Not assigned	Yes		[2.2]
	No		[2.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as follows:

a) units with seats

One person per seat or one person per 0,50 m of bench

b) Units without seats

Two persons per m^2 of the area reserved to public.

1.3 Categories of units

1.3.1 V type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 13. (No category 5).

2 Fire fighting

2.1 General requirements

2.1.1 Water supply systems

In addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], V- type units are subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

2.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

2.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

2.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

2.2 Alternative requirements

2.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [2.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

2.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed, with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher
- Portable fire extinguishers appropriate to the particular risks.

2.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 12 W TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as administration, offices or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated as follows:

a) Interior facilities provided

One person per 10 m^2 of spaces intended to public (halls, ticket offices, waiting room, etc)

b) Interior facilities not provided

One person per 100 m^2 of floor surface.

1.3 Categories of units

1.3.1 W type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:

- Archive spaces and paper storage
- Print workshops.

2.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- Store reserves
- Copy shops
- Spaces for conservation of electronic records
- Spaces containing at least 150 liters of flammable liquids.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station
b) close to each entrance from the deck to accommodation areas
c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas
d) at each entrance to machinery spaces
e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed
f) at each entrance to spaces in which materials presenting a fire hazard are stored
g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces
b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.
c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 13 X TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as sport centers or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Maximum number of persons

1.2.1 The maximum number of persons admitted together on board is to be defined by the designer.

1.3 Categories of units

1.3.1 X type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:

- spaces containing refrigeration systems.

2.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- Garment spaces
- Spaces for storage of carpets or equivalent materials, which are not permanently open on a playground
- Spaces containing disinfectants for swimming pool water.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, such that no position in the space is more than 15 metres walking distance away from an extinguisher, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

SECTION 14 Y TYPE UNIT

Symbols

H : Distance with respect to evacuation deck defined in Pt B, Ch 1, Sec 2, [1.12].

1 General

1.1 Application

1.1.1 The requirements of this Section apply, in addition to those stated in the previous Chapters, to safety of public and staff on board floating establishments intended to be operated as museum or similar activities.

1.1.2 The Articles of this Section are to be applied according to Tab 1, to the various floating establishments.

Table 1 : Requirements applicable to various floating establishments

Autonomous	Compliance with Pt C, Ch 3, Sec 1, [1.3.3]	Applicable requirements	
		General	Specific
Assigned	Not applicable	[1], [2]	[3.1]
Not assigned	Yes		[3.2]
	No		[3.1]

1.2 Determination of the number of persons

1.2.1 The maximum number of persons admitted together on board is to be determined by the designer.

1.2.2 Where the maximum number of persons is not known, it may be estimated on the basis of one person per 5 m^2 of the surface of the rooms open to the public.

1.3 Categories of units

1.3.1 Y type units are subdivided into categories according to Pt A, Ch 1, Sec 1, [1.2.4], where n_0 is to be taken equal to 200.

2 Containment of fire

2.1 Accommodation spaces with particular fire hazard

2.1.1 For the purposes of the provisions of Pt C, Ch 3, Sec 7, the spaces with particular fire hazard are defined in [2.1.2] and [2.1.3].

2.1.2 Spaces of major fire hazard

Spaces of major fire hazard include:

- Reserve of art works, collections, documents and other combustible items
- Restoration workshops
- Archive spaces
- Spaces for packaging and handling of waste
- Maintenance and repair workshops.

2.1.3 Spaces of moderate fire hazard

Spaces of moderate fire hazard include:

- Photographic Workshops
- Spaces containing at least 150 liters of flammable liquids.

3 Fire fighting

3.1 General requirements

3.1.1 Water supply systems

Units other than those of **Cat 5** are, in addition to the applicable requirements of Pt C, Ch 3, Sec 6, [3], subject to the following requirements:

a) It must be possible to project at least two jets of water simultaneously on any part of the unit from two different hydrants using for each a single length of hose not more than 20 m long. The length of throw must be at least 12 m with a nozzle diameter of 12 mm.

b) The minimum capacity of the fire pump is to be 20 m^3/h.

c) If the fire pump is located in the machinery space, a second power-driven fire pump shall be provided outside the machinery space. The pump drive must be independent of the machinery space, and the pump capacity shall conform to the preceding requirement items a) and b).

   Connections in the piping system with the machinery space shall be capable of being shut off from outside at the point of entry into the machinery space.

   A portable pump may be accepted, provided that a permanently installed pump is available in the machinery space.

d) Two fire hoses with dual-purpose nozzles are to be located in hose boxes in both unit ends. Further fire hoses may be required depending on the size and structural features of the unit.

3.1.2 Portable fire extinguishers

Portable fire extinguishers of appropriate types, complying with Pt C, Ch 3, Sec 6, [2], are to be provided as follows.

One portable fire extinguisher each is to be provided:

a) in the control station

b) close to each entrance from the deck to accommodation areas

c) close to each entrance to spaces which are not accessible from the accommodation area and which contain heating, cooking or cooling equipment operated with solid or liquid fuels or with liquefied gas

d) at each entrance to machinery spaces

e) at each entrance to spaces in which oil-fired auxiliary boilers or heating boilers are installed

f) at each entrance to spaces in which materials presenting a fire hazard are stored

g) at suitable points below deck in machinery spaces such that no position in the space is more than 10 metres walking distance away from an extinguisher.

In addition, the following applies:

a) one additional fire extinguisher is to be provided for each unit of 120 m^2, or part thereof, of the gross floor area in public spaces

b) galleys and shops shall, depending on their size and contents, be provided with additional fire extinguishers.

c) these additional fire extinguishers are to be installed and distributed on the unit so that, in the event of fire starting at any point and at any time, a fire extinguisher can be reached immediately.

3.1.3 Fixed gas fire extinguishing systems

Machinery spaces containing internal combustion engines shall be provided with a fixed gas fire extinguishing system in compliance with Pt C, Ch 3, Sec 6, [7].

3.1.4 Automatic pressure water spraying systems

Where installed, automatic pressure water spraying systems are to be in compliance with Pt C, Ch 3, Sec 6, [6]. They shall be ready for operation at all times when the public is on board. No additional measures on the part of the staff shall be needed to actuate the system.

3.2 Alternative requirements

3.2.1 The requirements of this Sub-article apply, as an alternative to Sub-article [3.1], to units complying with the criteria defined in Pt C, Ch 3, Sec 1, [1.3.3].

3.2.2 The means for fire fighting on board the unit shall include:

- Portable fire extinguishers of sprayed water type, complying with Pt C, Ch 3, Sec 6, [2], judiciously distributed:
  - with a minimum of one extinguisher per 300 m^2 and per level, for units of **Cat 5**
  - with a minimum of one extinguisher per 200 m^2 and per level, for units of other categories
- Portable fire extinguishers appropriate to the particular risks.

3.2.3 In addition, a dry main system for fire fighting, complying with Pt C, Ch 3, Sec 6, [5], is to be installed in protected stairways if H exceeds 18 m.

Note 1: Protected stairways are stairways in which the public is protected from the flames and smoke.

Part D
Additional Requirements for Notations

Chapter 2
ADDITIONAL CLASS NOTATIONS

SECTION 1 COMFORT ON BOARD

Symbols

dB : Decibel, unit of sound pressure level compared to the reference pressure level (2.10^{-5} Pa)

dB(A) : (A) weighted global value of the sound pressure level

octave band: Frequency space limited by a given frequency and twice this frequency. Third (1/3) octave band corresponds to a frequency space of 1/3 octave. Octave and thirds bands used in accoustics are standard bands (IEC).

1 General

1.1 Application

1.1.1 The additional class notation **FE-COMF(N-V)** is assigned, in accordance with Pt A, Ch 1, Sec 2, [1.8.2] to units complying with the requirements of this Section.

1.2 Basic principles

1.2.1 Granting of the comfort grade is made on the basis of measurements performed by an acoustic and vibration specialist from the Society during building stage or in service. However, measurements may be performed by another acoustic and vibration specialist from external company provided that this specialist has duly obtained the relevant delegation from the Society.

1.2.2 These Rules take into account various International Standards, and are deemed to preserve their general principles.

1.3 Regulations, Standards

1.3.1 Noise

The present Section refers to the following standards applicable to noise:

- IMO Resolution A.468 (XII), "Code on noise levels onboard ships"
- ISO 2923, "Acoustics - Measurements of noise on board vessels"
- ISO 31/VII, "Quantities and units of acoustics"
- IEC Publication 61672, "Electroacoustics-Sound level meters"
- IEC Publication 61260, "Octave, half-octave and third octave band filters"
- IEC Publication 60942, "Electroacoustics - Sound calibrators"
- ISO 140, "Acoustics - Measurements of sound insulation in buildings and of building elements", namely:
  - Part 4, "Field measurements of airborne sound insulation between rooms"
  - Part 7, "Field measurements of airborne impact insulation of floors"
  - Part 13, "Guidelines"
  - Part 14, "Guidelines for special situation in the field"
- ISO 717, "Acoustics - Rating of sound insulation in buildings and of building elements", namely:
  - Part 1, "Airborne sound insulation in buildings and interior elements"
  - Part 2, "Impact sound insulation"
- IEC Publication 60268-16, "Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index"
- ISO 1996, "Acoustics - Description, measurements and assessment of environmental noise", namely:
  - Part 1, "Basic quantities and assessment procedure"
  - Part 2, "Determination of environmental noise levels".

1.3.2 Vibration

The present Section refers to the following standards applicable to vibration:

- ISO 2041, "Vibration and shock - Vocabulary"
- ISO 6954:1984, "Mechanical vibration and shock - Guidelines for the overall evaluation of vibration in merchant ships"
- ISO 6954:2000, "Mechanical vibration - Guidelines for measurements, reporting and evaluation of vibration with regard to habitability on passenger and merchant ships"
- ISO 2631, "Mechanical vibration and shock- Evaluation of human exposure to whole-body vibration"
- ISO 8041, "Human response to vibration - Measuring instrumentation".

1.4 Definitions

1.4.1 The following definitions are used in the present Section for the concerned units:

- Public spaces
  - Type A public space

    closed rooms normally manned or recreational spaces where noise is generally high (discotheques)
  - Type B public space

    closed rooms permanently manned where noise may be moderately high (restaurants, bars, cinemas, casinos, lounges)

- Type C public space

  closed rooms permanently manned requiring relatively low background noise (lecture rooms, libraries, theatres)
- Type D public space

  closed rooms intermittently used or passages which do not require very low background noise (halls, atriums, shops, corridors, staircases, sport rooms, gymnasiums)

• Bedrooms
  - bedroomss are dealt with separately. Distinction between public bedroomss categories is to be made on the basis of Owner's specifications.

1.5 Document to be submitted

1.5.1 Prior to any trials, documents listed in Tab 1 are to be submitted in relation with unit type and categories.

Table 1 : Documents to be submitted

N0	A/I	Document
1	I	General arrangements
2	A	List of measuring points: • noise level in service conditions • vibration level in service conditions • insulation measurements • impact measurements
3	A	Measurement program: • loading conditions • auxiliary machinery operating conditions • other equipment to be run • weather conditions • measuring instruments
A = to be submitted for review/approval I = to be submitted for information		

2 Conditions of attribution

2.1 Measurements

2.1.1 Measurements aiming at giving the comfort class notation have to be performed under the conditions specified in [3].

2.1.2 Instrumentation

a) General

Measurement and calibration equipments are to meet the requirements of ISO 2923, IEC 61672, IEC 61260 and IEC 60942 for noise, and ISO 6954 and ISO 8041 for vibration.

Sound insulation measurement is to be carried out according to ISO 140-4 and ISO 140-14.

Impact measurement is to be carried out according to ISO 140-7 and ISO 140-14.

Noise and vibration calibrators are to be verified at least every year. Measuring equipments are to be verified at least every two year. This verification is to be done by a national standard laboratory or a competent laboratory accredited according to ISO 17025 (2005) as corrected by (Cor 1:2006).

b) Noise measurements

The instrumentation has to be calibrated in situ, before and after the tests.

c) Vibration measurements

The instrumentation has to include at least a transducer (accelerometer or velocity transducer) with an appropriate amplifier, and a FFT analyser. The instrumentation has to be calibrated in situ, before and after the tests. Should the vibration measurements be performed on a soft floor, the use of a tripod mount is recommended.

2.1.3 Data processing - Analysis

a) For noise level

The nominal noise level is evaluated with LAeq,T value. LAeq,T (dB(A) re. 20µPa) is the equivalent continuous A weighted sound pressure level, T greater than 20 seconds.

Results have to be given on a table in global values (dB(A)).

b) For vibration level

The criteria of vibration is to be expressed either in terms of overall frequency-weighted r.m.s. velocity (mm/s) from 1 to 80Hz as defined by ISO 6954:2000.

2.1.4 When it is not possible for the Society to follow or to do all the required measurements, spot-check is to be performed by the Society. This spot-check consists of a cross-comparison between:

- a sample of at least 10% of the measurements provided by the shipyard/external specialist (see [2.1.4], Note 1)
- and the corresponding readings obtained during the spot-check measurements.

This procedure enables the validation of the entire set of measurements provided by the shipyard/external specialist.

Note 1: The maximum deviations allowed during the cross-comparison are 2 dB(A) for noise measurements and 0,5 mm/s for vibration measurements.

2.2 Determination of comfort rating number

2.2.1 The notation is completed between brackets by two parameters **N** and **V**, with possible value **1**, **2** or **3**, which represents the comfort levels achieved with respect to noise and vibration, respectively.

The grade 1 corresponding to the most comfortable lnoise of vibration level.

2.2.2 Levels are measured in several locations of each space of the unit. The granted comfort class grade is given on condition that none of the measured levels exceeds the corresponding requested limits.

A tolerance on noise levels may be accepted but shall not exceed the following maximum values:

- 3 dB(A) for 18% of all measured bedrooms and 5 dB(A) for 2% of all measured bedrooms (with a minimum of 1 bedroom).

- 3 dB(A) for 25% of measuring points and 5 dB(A) for 5% of measuring points, in other spaces.
- 1 dB for 20% of apparent weighted sound reduction indexes R'w and impact noise indexes L'n,w and 2 dB for 10% of apparent weighted sound reduction indexes R'w and impact noise indexes L'n,w (with a minimum of 1 partition or floor).

A tolerance on vibration levels may be accepted but shall not exceed 0,3 mm/s for 20% of measuring points in all public and staff spaces for overall frequency weighted r.m.s. velocity criteria.

2.3 Measuring locations

2.3.1 The list of measuring points is to be prepared prior to the tests (see [1.5.1]).

3 Testing conditions

3.1 General

3.1.1 This Article gives the conditions to be fulfilled during measurements. Additional details of these conditions may be taken from International Standards, respectively:

- IMO Resolution A.468 (XII), ISO 2923 for noise
- ISO 6954 for vibrations.

3.1.2 Prior to the tests, possible divergence on the required conditions may be accepted by the Society. If any, it is to be clearly mentioned in the report.

3.1.3 The measurement program, has to be approved before the trials (see [1.5.1]). During the tests, some additional measurements may be decided upon request of the Society.

3.1.4 During measurements, especially for noise, rooms have to be preferably fully completed (outfitting, furniture, covering...). Measurements may be performed even in an unfinished state, which generally suppose better final results.

3.2 Test conditions

3.2.1 The tests are to be performed and measurements are to be taken with conditions corresponding to normal service conditions.

3.2.2 Frequently used equipment (more than 1/3 of the operation time) is to be run at its normal operating conditions (If practicable). The list of machine and equipment to be run during the tests is, at least, to include (if present) the following:

- generating sets
- air conditioning and machinery ventilation
- evaporators
- compressors, chillers
- cold rooms
- waste treatment units
- swimming pool with pumps
- jacuzzi and thalassotherapy equipment
- laundry with the entire equipment running: drying (spin dryer or tumble dryer) and washing machines (for measurements inside laundry, equipment is to be stopped).

4 Noise

4.1 Measurement procedure

4.1.1 Measuring conditions

Tests have to be conducted in the conditions described in [3]. Air conditioning is to be in normal operation. Doors and windows have to be closed, unless they have to be kept open in normal use.

It may happen that the measurements cannot be performed with machinery equipments and machinery ventilation in normal operation (as defined in [3]). In such case, additional measurements should be done at quay and taken into account in the final results.

4.1.2 Measuring positions

a) Noise measurements

   Measurements are to be taken at a height between 1,2 and 1,6 m from the deck and at a distance above 1,0 m from any boundary surface of the room. In bedrooms and offices, one measurement will be performed in the middle of the space. Additional measurements should be performed in other locations if appreciable sound level differences inside the room occur.

   On open decks, measurements are to be taken at 2 m at least from the existing noise sources (e.g. inlet/outlet of ventilation).

   In bedrooms, measurements are to be carried out at the centre of the bedroom.

   The location and number of measuring points are defined as follows:

   - minimum of 35% of bedrooms,
   - all public spaces and open decks.

   For large public rooms (lounges, restaurants…) measurements are to be carried out in different locations, each measuring point covering less than 50 m^2.

Note 1: The Society may accept a lower number of measuring points or a modification of the points distribution for specific cases.

b) Sound insulation measurements

   The selection of insulation measuring locations is to be representative of the different types of insulation provided in Tab 2 and Tab 3 (a minimum of two measurements of each type is required).

c) Impact measurements

   The selection of impact measuring locations is to be representative of the different deck coverings implemented on the unit (a minimum of two measurements of each deck covering is required).

4.2 Noise levels

4.2.1 Noise levels in standard spaces defined in [1.4] and corresponding to the noise grade **N** are provided in Tab 4.

Noise levels described in IMO Resolution A.468 (XII) are applicable for all locations unlisted in Tab 4.

4.3 Sound insulation measurements

4.3.1 Between two adjacent accommodation spaces, acoustic insulation has to satisfy the requirements given in Tab 2 and Tab 3. Measurements are to be performed in situ.

Table 2 : Apparent weighted sound reduction indexes R'w in dB for public areas

Locations	grade = 1	grade = 2	grade = 3
Bedroom to bedroom (top level)	45	42	40
Bedroom to bedroom (standard)	41	38	36
Bedroom to bedroom with communication door (standard)	40	37	35
Corridor to bedroom (top level)	42	40	37
Corridor to bedroom	38	36	34
Stairs to bedroom	48	45	45
Public spaces to bedroom	53	50	48
Discotheques and show rooms to bedroom	64	62	60

Table 3 : Apparent weighted sound reduction indexes R'w in dB for staff areas

Locations	grade = 1	grade = 2	grade = 3
Bedroom to bedroom	37	33	30
Corridor to bedroom	35	32	30
Stairs to bedroom	35	32	30
Public spaces, mess to bedroom	45	45	45

Table 4 : Noise levels

Noise levels, in dB (A)			
Locations **(1)**	grade = 1	grade = 2	grade = 3
Public top level bedrooms	45	47	50
Public standard bedrooms	49	53	56
Restaurants, cafeterias and type B spaces **(1)**	55	58	62
Public shop, passages (type D) **(1)**	60	63	65
Public spaces (type A) **(1)**	65	68	72
Public spaces (type C) **(1)**	53	56	59
Outside installations (swimming pools, sport decks...) **(2)** **(4)**	65	70	75
Control stations	60	63	65
Radio room **(3)**	55	57	60
Staff bedrooms	52	55	60
Offices	57	60	63
Staff spaces, mess rooms	57	60	63
Hospital	55	57	60
Engine control room **(3)**	70	73	75
Staff open recreation areas **(2)**	70	73	75
Galleys **(2)**	70	73	76
Workshops **(2)**	85	85	85
Alleyways, staircases and passages in staff areas	70	73	75

(1) For the definition of type A to type D public spaces, refer to [1.4].
(2) A tolerance of 5 dB (A) may be accepted for measurements at less than 3 m from ventilation inlet/outlet.
(3) Equipment switched on but not processing.
(4) Measurement carried out with a windscreen microphone protection.

4.4 Impact measurements

4.4.1 A weighted normalised impact sound pressure level L'n,w is to be kept below 50 dB for the bedrooms. It is to be increased to 60 dB for bedrooms below decks covered with hard materials (wood, marble, tiles, etc). For bedrooms located below sport rooms or dance floors, this value is to be kept below 45 dB.

5 Vibration

5.1 Measurement procedure

5.1.1 Measuring conditions

Tests are to be conducted under the conditions described in [3].

5.1.2 Measuring positions

Measurements are to be taken in vertical direction. In bedrooms, offices or other small size rooms, measurements are to be taken on the floor in the centre of the room. For larger rooms, several measuring points may be required and are to be chosen according to the local structure (measurements of the different existing types of stiffened panels).

In bedrooms, the measurements are to be carried out at the centre of the bedroom.

The location and number of measuring points are defined as follows:

- minimum of 20% of bedrooms,
- all public spaces and open decks.

For large public rooms (lounges, restaurants…) measurements are to be carried out in different locations, each measuring point covering less than 50 m^2.

Note 1: The Society may accept a lower number of measuring points or a modification of the points distribution for specific cases.

In addition to vertical direction, measurements in transverse and longitudinal directions are to be performed every 3 decks, with one measuring point in the end parts of the unit and one in the middle part.

5.2 Vibration levels

5.2.1 Vibration levels corresponding to the vibration grade **V** are provided in Tab 5 in accordance to ISO 6954 - 2000 (the limits listed below are applicable for any directions).

Table 5 : Overall frequency weighted r.m.s. vibration levels

Vibration velocity (mm/s) values from 1 Hz to 80 Hz			
Locations	grade = 1	grade = 2	grade = 3
Public top level bedrooms	1,7	2	2,2
Public standard bedrooms	2,0	2,5	3,0
Restaurants, cafeterias and type B spaces **(1)**	2,2	2,5	3,0
Public shops, passages (type D) **(1)**	4,0	4,5	5,0
Public spaces (type A) **(1)**			
Public spaces (type C) **(1)**	2,0	2,5	3,0
Outside installations (swimming pools, sport decks...)	3,0	3,5	4,0
Control stations	2,8	3,0	3,2
Radio room			
Staff bedrooms	2,8	3,0	3,2
Offices	3,0	3,5	4,0
Staff spaces, mess rooms	3,0	3,5	4,0
Hospital	2,8	3,0	3,0
Engine control room	4,0	5,0	6,0
Staff open recreation areas	–	–	–
Galleys	5,0	5,5	6,0
Workspaces			
Alleyways, staircases and passages in staff areas	5,0	5,5	6,0
(1) For the definition of type A to type D public spaces, refer to [1.4].			

SECTION 2 DAMAGE STABILITY

Symbols

L : Rule length, in m, defined in Pt B, Ch 1, Sec 2, [1.1]

B : Breadth, in m, defined in Pt B, Ch 1, Sec 2, [1.2]

D : Depth, in m, defined in Pt B, Ch 1, Sec 2, [1.3]

T : Draught, in m, defined in Pt B, Ch 1, Sec 2, [1.4]

L_{WL} : Length of waterline, in m, defined in Pt B, Ch 1, Sec 2, [1.6]

Δ : Displacement, in tons, at draught T

C_B : Block coefficient, defined in Pt B, Ch 1, Sec 1

KG : Height, in m, of the centre of gravity above base line.

1 General

1.1 Application

1.1.1 Units complying with the requirements of this Section are eligible for the assignment of additional class notation **FE-Damage stability**, as defined in Pt A, Ch 1, Sec 2, [1.8.3].

1.2 Documents to be submitted

1.2.1 The documents to be submitted are listed in Pt B, Ch 2, Sec 2, [2.1].

The Society may require any other necessary guidance for the safe operation of the unit.

1.2.2 General requirements of Pt B, Ch 2, Sec 2 are to be complied with.

1.3 General requirements

1.3.1 Proof of appropriate damage stability of the unit shall be furnished by means of a calculation based on the method of lost buoyancy. All calculations shall be carried out free to trim and sinkage.

1.3.2 Buoyancy of the unit in the event of flooding shall be proven for the standard load conditions specified in Pt B, Ch 2, Sec 2, [4.1.2]. Accordingly, mathematical proof of sufficient stability shall be determined for the three intermediate stages of flooding (25%, 50% and 75% of flood build-up) and for the final stage of flooding.

1.3.3 Floating establishments shall comply with the one-compartment status.

2 Assumptions

2.1 General

2.1.1 In the event of flooding, assumptions concerning the extent of damage given in Tab 2 shall be taken into account.

2.1.2 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 measured rectangular to centre line from the shell plating at the maximum draught plane shall not be taken into account for calculation purposes.

2.1.3 The lowest point of every non-watertight opening (e.g. doors, windows, access hatchways) shall lie at least 0,10 m above the damage waterline. The bulkhead deck shall not be immersed in the final stage of flooding.

2.1.4 Permeability is assumed to be 95%. If it is proven by a calculation that the average permeability of any compartment is less than 95%, the calculated value can be used instead.

The values to be adopted shall not be less than those given in Tab 1.

2.1.5 If damage of a smaller dimension than specified above produces more detrimental effects with respect to listing or loss of metacentric height, such damage shall be taken into account for calculation purposes.

Table 1 : Permeability values, in %

Spaces	μ
Lounges	95
Engine rooms	85
Luggage and store rooms	75
Double bottoms, fuel bunkers and other tanks, depending on whether, according to their intended purpose, they are to be assumed to be full or empty for the unit floating at the plane of maximum draught	0 or 95%

Table 2 : Extent of damage, in m

Damage location	Dimension of the damage	
Wall	longitudinal ℓ	0,1 $L_{WL} \geq 4$
	transverse b	B / 5
	vertical h	from unit bottom to top without delimitation
Bottom **(2)**	longitudinal ℓ	1
	transverse b	1
	vertical h	0,59; pipework shall be deemed intact **(1)**

(1) Where a pipework system has no open outlet in a compartment, the pipework 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 off the bottom of the unit.
(2) May be disregarded if the water stretch level is relatively constant (e.g., no season or tide effect).

3 Damage stability criteria

3.1 Criteria

3.1.1 For all intermediate stages of flooding referred to in Pt B, Ch 2, Sec 2, [4.1.4], the following criteria shall be met:

- the angle of heel φ at the equilibrium position of the intermediate stage in question shall not exceed 15°
- beyond the inclination in the equilibrium position of the intermediate stage in question, the positive part of the righting lever arm curve shall display a righting lever arm value of GZ ≥ 0,02 m before the first unprotected opening becomes immersed or in any case before reaching an angle of heel φ of 25°
- non-watertight openings shall not be immersed before the inclination in the equilibrium position of the intermediate stage in question has been reached.
- the calculation of the free surface effect in all intermediate stages of flooding shall be based on the gross surface area of the damaged compartments.

3.1.2 During the final stage of flooding, the following criteria shall be met (see Fig 1) taking into account the heeling moment due to persons in accordance with Pt B, Ch 2, Sec 2, [4.1.4]:

- the angle of heel φ_E shall not exceed 10°
- beyond the equilibrium position the positive part of the righting lever arm curve shall display a righting lever arm value of $GZ_R \geq 0,02$ m with an area $A \geq 0,0025$ m·rad. These minimum values for stability shall be met until the immersion of the first unprotected opening or in any case before reaching an angle of heel $\varphi_m \leq 25°$
- non-watertight openings shall not be immersed before the trimmed position has been reached; if such openings are immersed before this point, the rooms affording access are deemed to be flooded for damage stability calculation purposes.

3.1.3 The shut-off devices which shall be able to be closed watertight shall be marked accordingly.

3.1.4 If cross-flood openings to reduce asymmetrical flooding are provided, they shall meet the following conditions:

a) for the calculation of cross-flooding, IMO Resolution A.266 (VIII) shall be applied

b) they shall be self-acting

c) they shall not be equipped with shut-off devices

d) the total time allowed for compensation shall not exceed 15 minutes.

4 Safety clearance and freeboard

4.1 General

4.1.1 The requirements of this Sub-article do not apply to units of **Cat 5**.

4.2 Safety clearance

4.2.1 The safety clearance shall be at least equal to the sum of:

a) the additional lateral immersion, which, measured on the outside plating, is produced by the permissible angle of heel according to Pt B, Ch 2, Sec 2, [4.1.3] e), and

b) the residual safety clearance according to Pt B, Ch 2, Sec 2, [4.1.3]g).

For units without a bulkhead deck, the safety clearance shall be at least 500 mm.

4.3 Freeboard

4.3.1 The freeboard shall correspond to at least the sum of:

a) the additional lateral immersion, which, measured on the outside plating, is produced by the angle of heel according to Pt B, Ch 2, Sec 2, [4.1.3] e), and

b) the residual freeboard according to Pt B, Ch 2, Sec 2, [4.1.3] f).

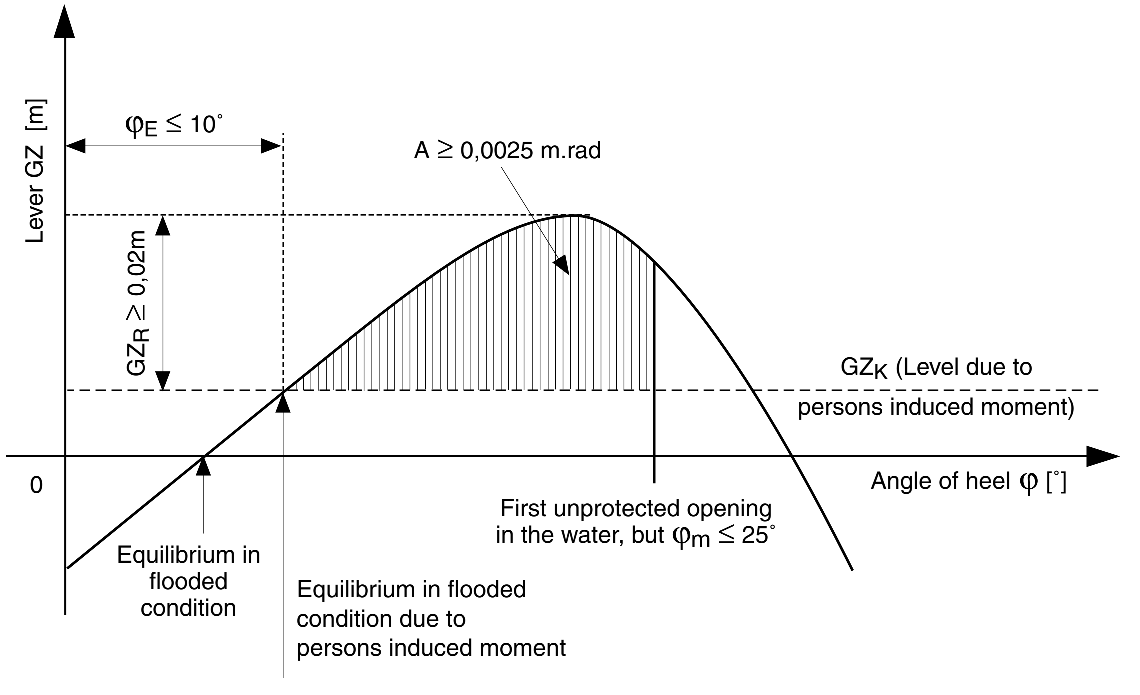
The freeboard shall be at least 300 mm.

4.4 Other requirements

4.4.1 The plane of maximum draught is to be set so as to ensure compliance with the safety clearance according to [4.2], and the freeboard according to [4.3].

4.4.2 For safety reasons, the Society may stipulate a greater safety clearance or a greater freeboard.

Figure 1 : Proof of damage stability (final stage of flooding)



SECTION 3 EQUIPPED FOR WHEELED VEHICLES

1 General

1.1 Application

1.1.1 Floating units complying with the requirements of this Section are eligible for the assignment of the additional class notation **FE-Equipped for wheeled vehicles**, as defined in Pt A, Ch 1, Sec 2, [1.8.4].

1.1.2 These units are to comply with the requirements stated under Part A, Chapter 1 to Part D, Chapter 1, as far as applicable.

1.2 Documentation to be submitted

1.2.1 In addition to the documentation required in Pt B, Ch 1, Sec 3, [1], the following information is to be submitted:

a) Plans of ramps and movable decks, if any
b) Plan of arrangement of vehicles
c) Characteristics of vehicles: (as applicable) axle load, axle spacing, number of wheels per axle, wheel spacing, size of tyre print.

2 Unit arrangements

2.1 Sheathing

2.1.1 Wood sheathing is recommended for tracked vehicles.

It is recommended that a piece of wood of suitable thickness should be provided under each crutch in order to distribute the mass over the plate and the nearest stiffeners.

2.2 Hull structure

2.2.1 Framing

In general, the strength deck and the bottom are to be longitudinally framed.

Where a transverse framing system is adopted for such structures, it is to be considered by the Society on a case-by-case basis.

3 Hull scantlings

3.1 General

3.1.1 The hull scantlings and arrangements are to be in compliance with the applicable requirements of Part B, Chapter 1.

3.1.2 In addition, scantlings of plating and structural members subjected to wheeled loads are to be in compliance with NR217, Pt D, Ch 1, Sec 5.

4 Other structures

4.1 Ramps

4.1.1 The scantlings of ramps are to be in compliance with Pt B, Ch 7, Sec 2, [1].

SECTION 4 OPERATION IN ICE ENVIRONMENT

Symbols

UWL : Upper waterline, defined in [1.3.1]

LWL : Lower waterline, defined in [1.3.2]

s : Spacing, in m, of ordinary stiffeners

S : Spacing, in m, of primary supporting members

ℓ : Span, in m, of ordinary stiffeners or primary supporting members, as applicable

R_{eH} : Minimum yield stress, in N/mm², of the material as defined in Pt B, Ch 2, Sec 3, [2.1]

p : Design ice pressure, in N/mm², defined in [2.4.5]

h : Height, in m, of load area defined in [2.4.4].

1 General

1.1 Application

1.1.1 The following additional class notations are assigned, in accordance with Pt A, Ch 1, Sec 2, [1.8.6] to units strengthened for operation in ice and complying with the relevant requirements of this Section :

- **FE-Ice(20)**
- **FE-Ice(30)**
- **FE-Ice(40)**

1.1.2 The ice strengthening requirements for **FE-Ice(40)** in this Section are equivalent to those corresponding to **ICE CLASS IC** in the "Finnish-Swedish Ice Class Rules 1985 as amended".

1.1.3 The ice strengthening requirements for the additional class notations **FE-Ice(20)** and **FE-Ice(30)** cover units operated in drift ice of thickness not exceeding the values defined in Tab 1.

1.2 Owner's responsibility

1.2.1 It is the responsibility of the Owner to decide which ice class notation is the most suitable in relation to the expected service conditions of the unit.

1.3 Definitions

1.3.1 Upper waterline

The upper waterline (UWL) is the highest waterline at which the unit is intended to operate in ice. The line may be a broken line.

1.3.2 Lower waterline

The lower waterline (LWL) is the lowest waterline at which the unit is intended to operate in ice.

1.3.3 Ice belt

The ice belt is that portion of the side shell which is to be strengthened. Its vertical extension is defined in Tab 2.

1.4 Draught limitations

1.4.1 Maximum draught

The draught and trim limited by the UWL are not to be exceeded when the unit is operating in ice.

1.4.2 Minimum draught

The unit is always to be loaded down to at least the LWL when operating in ice. Any ballast tank situated above the LWL and needed to load down the unit to this water line is to be equipped with devices to prevent the water from freezing.

1.5 Documentation to be submitted

1.5.1 The plans relevant to the shell expansion and end part structures are to define, at midship and at ends, the upper waterline (UWL) and the lower waterline (LWL) .

1.6 Ice thickness

1.6.1

a) An ice strengthened unit is assumed to operate in conditions corresponding to an ice level with a thickness not exceeding the value h_G.

b) The design height of the area actually under ice pressure at any time is, however, assumed to be only a fraction h, of the ice thickness h_G.

c) The values for h_G and h, in m, are given in Tab 1.

Table 1 : Ice thickness h_G and fraction h

Ice class notation	h_G (m)	h (m)
FE-Ice(20)	0,2	0,075
FE-Ice(30)	0,3	0,10
FE-Ice(40)	0,4	0,22

2 Hull

2.1 Ice strengthened area vertical extension

2.1.1 The ice strengthened area extends:

- as defined in Tab 2 for plating
- from the deck down to the bilge turn, for ordinary stiffeners and primary supporting members.

Table 2 : Vertical extension of ice strengthened area for plating (ice belt)

Notation	Vertical extension of ice strengthened area, in m	
	above UWL	below LWL
FE-Ice(20)	0,3	0,3
FE-Ice(30)		
FE-Ice(40)	0,4	0,5

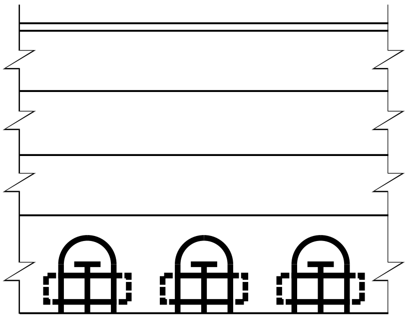
2.2 General framing arrangement

2.2.1 The frame spacings and spans in this Section are normally assumed to be measured along the plate and perpendicular to the axis of the stiffener for plates, along the flange for members with a flange, and along the free edge for flat bar stiffeners. For curved members the span (or spacing) is defined as the chord length between span (or spacing) points. The span points are defined by the intersection between the flange or upper edge of the member and the supporting structural element (stringer, web frame, deck or bulkhead).

2.2.2 Within the ice strengthened area defined in [2.1.1], all ordinary stiffeners are to be attached to the supporting structure by means of brackets.

Ordinary stiffeners are to be connected to primary supporting members structure on both sides (i.e. a free edge of a scallop is to be connected to the ordinary stiffener by collar plates, as shown in Fig 1).

Figure 1 : End connection of ordinary stiffener Two collar plates



2.2.3 For the ice strengthened area of units with additional class notations **FE-Ice(40)**, the following requirements are to be complied with:

- frames that are not normal to the plating or the profile is unsymmetrical, and the span exceeds 4,0 m, are to be supported against tripping by brackets, intercostals, stringers or similar at a distance not exceeding 1,3 m. If the span is less than 4,0 m, the supports against tripping are required for unsymmetrical profiles and stiffeners the web of which is not normal to plating
- ordinary stiffeners are to be attached to the shell by double continuous welds; no scalloping is allowed (except when crossing shell plate butts)
- the web thickness of the ordinary stiffeners are to be at least half that of the shell plating; where there is a deck, tank top or bulkhead in lieu of an ordinary stiffener the plate thickness is to be complied with, to a depth corresponding to the height of adjacent ordinary stiffeners.

2.3 Transverse framing arrangement

2.3.1 Upper end of transverse framing

The upper end of the strengthened part of a main ordinary stiffener and intermediate ice ordinary stiffener is to be attached to a deck or an ice side girder as required in [2.5.6] and [2.5.7].

Where an intermediate ordinary stiffener terminates above a deck or an ice side girder which is situated at or above the upper limit of the ice strengthened area, the part above the deck or side girder may have the scantlings required for an unstrengthened vessel and the upper end may be connected to the adjacent main ordinary stiffeners by an horizontal member of the same scantlings as the main ordinary stiffener.

2.3.2 Lower end of transverse framing

The lower end of the strengthened part of a main ordinary stiffener and intermediate ice ordinary stiffener is to be attached to a tank top or an ice side girder as required in [2.5.6] and [2.5.7].

Where an intermediate ordinary stiffener terminates below a tank top or an ice side girder which is situated at or below the lower limit of the ice strengthened area, the lower end may be connected to the adjacent main ordinary stiffeners by an horizontal member of the same scantlings as the ordinary stiffeners.

2.4 Design loads

2.4.1 Because of the different flexural stiffness of plating, ordinary stiffeners and primary supporting members, the ice load distribution is to be assumed to be as shown in Fig 2.

2.4.2 The formulae and values given in this Section may be substituted by direct analysis if they are deemed by the Society to be invalid or inapplicable for a given structural arrangement or detail. Otherwise, direct analysis is not to be utilized as an alternative to the analytical procedures prescribed by explicit requirements.

2.4.3 If scantlings obtained from the requirements of this Article are less than those required for the unstrengthened unit, the latter are to be used.

2.4.4 Height of load area

The height of the area under ice pressure at any particular point of time is to be obtained, in m, from Tab 3 depending on the additional class notation assigned to the unit.

2.4.5 Design ice pressure

The value of the design ice pressure p, in N/mm^2, to be considered for the scantlings check, is obtained from the following formula:

$$p = c_d c_1 c_a p_o$$

where:

c_d : Coefficient defined as:

$C_d = 0,214$

c_1 : Coefficient taking account of the probability of the design ice pressure occurring on the hull

$C_1 = 0,50$

c_a : Coefficient taking account of the probability that the full length of the area under consideration will be under pressure at the same time, to be obtained from the following formula:

$$c_a = \frac{47 - 5\ell_a}{44}$$

without being taken less than 0,6 nor greater than 1,0

ℓ_a : Distance, in m, defined in Tab 4

p_0 : Nominal ice pressure, in N/mm², to be taken equal to 5,6.

Figure 2 : Ice load distribution on unit side

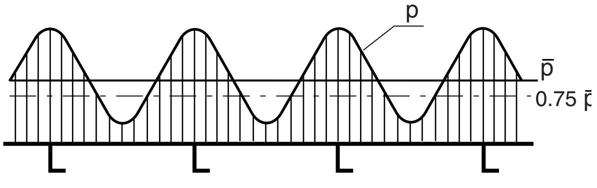


Table 3 : Height of load area

Notation	h, in m
FE-Ice(20)	0,075
FE-ce(30)	0,10
FE-Ice(40)	0,22

Table 4 : Distance ℓ_a

Structure	Type of framing	ℓ_a
Shell plating	Transverse	Spacing of ordinary stiffeners
	Longitudinal	1,7 spacings of ordinary stiffeners
Ordinary stiffeners	Transverse	Spacing of ordinary stiffeners
	Longitudinal	Span of ordinary stiffeners
Vertical primary supporting members		Two spacings of vertical primary supporting members
Ice side girders		Span of side girders

2.5 Hull scantlings

2.5.1 Plating scantling - general

The plating thickness is to be strengthened according to [2.5.2] within the strengthened area for plating defined in [2.1.1].

2.5.2 Plating thickness in the ice strengthened area

The gross thickness of the shell plating is to be not less than the value obtained, in mm, from the following formula:

- for transverse framing:

$$t = 667s\sqrt{\frac{F_1 p_{PL}}{R_{eH}}} + t_c$$

- for longitudinal framing:

$$t = 667s\sqrt{\frac{p}{F_2 R_{eH}}} + t_c$$

where:

p_{PL} : Ice pressure on the shell plating to be obtained, in N/mm², from the following formula:

$$p_{PL} = 0,75p$$

F_1 : Coefficient to be obtained from the following formula:

$$F_1 = 1,3 - \frac{4,2}{\left[\frac{h}{s} + 1,8\right]^2}$$

without being taken greater than1,0

F_2 : Coefficient to be obtained from the following formula:

$$F_2 = 0,6 + 0,4\frac{s}{h}$$

t_C : Abrasion and corrosion addition, in mm, to be taken equal to 2 mm; where a special surface coating, by experience shown capable to withstand the abrasion of ice, is applied, a lower value may be accepted by the Society on a case by case basis.

2.5.3 Ordinary stiffeners scantling - general

Ordinary stiffeners are to be strengthened according to [2.5.4] and [2.5.5] within the strengthened area for ordinary stiffeners defined in [2.1.1].

2.5.4 Scantlings of transverse ordinary stiffeners

The gross section modulus w, in cm³ and the gross effective shear area A_{sh}, in cm², of transverse ordinary stiffeners are to be not less than the values obtained from the following formulae:

$$w = \frac{7 - 5(h/\ell)}{7m_0}\,\frac{psh\ell}{R_{eH}}\,10^6$$

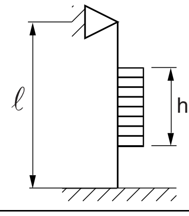
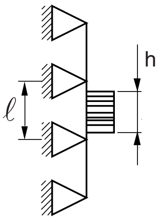
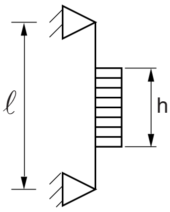
$$A_{sh} = \frac{\sqrt{3}F_3phs}{2R_{eH}}10^4$$

where:

F_3 : Coefficient which takes into account the maximum shear force versus the load location and the shear stress distribution and to be taken equal to 1,20

m_0 : Coefficient defined in Tab 5.

Table 5 : Coefficient m_0

Boundary condition	Example	m_0
Type 1 	Ordinary stiffeners extending from the tank top to a single deck	6,0
Type 2 	Continuous ordinary stiffeners between several decks or side girders	5,7
Type 3 	Ordinary stiffeners extending between two decks only	5,0
Note 1: The boundary conditions are those for the intermediate ordinary stiffeners. Possible different conditions for main ordinary stiffeners are assumed to be taken care of by interaction between the ordinary stiffeners and this is included in the m_0 values. **Note 2:** Load is applied at mid-span.		

2.5.5 Scantlings of longitudinal ordinary stiffeners

The gross section modulus w, in cm³ and the gross effective shear area A_{Sh}, in cm², of longitudinal ordinary stiffeners with or without brackets are to be not less than the values obtained from the following formulae:

$$w = \frac{F_4 p h \ell^2}{m_1 R_{eH}} 10^6$$

$$A_{Sh} = \frac{\sqrt{3} F_4 F_5 p h \ell}{2 R_{eH}} 10^4$$

where:

F_4 : Coefficient, taking account of the load distribution on adjacent ordinary stiffeners, to be obtained from the following formula:

$$F_4 = \left(1 - 0{,}2\frac{h}{s}\right)$$

F_5 : Coefficient which takes into account the pressure definition and maximum shear force versus load loacation and also shear stress distribution and to be taken equal to 2,16

m_1 : Boundary condition coefficient for the ordinary stiffener considered, to be taken equal to 13,3 for a continuous beam; where the boundary conditions deviate significantly from those of a continuous beam, e.g. in an end field, a smaller boundary condition coefficient may be required. In such a case, for ordinary stiffeners without brackets, a value of m = 11,0 is to be used.

Note 1: In calculating the actual shear area of longitudinal ordinary stiffeners, the area of the brackets is not to be taken into account.

2.5.6 Ice stringers

The section modulus w, in cm³ and the effective section area A_{Sh} , in cm², of an ice stringer are to be not less than the values obtained from the following formulae:

$$w = \frac{F_6 F_7 p h \ell^2}{m_S R_{eH}} 10^6$$

$$A_{Sh} = \frac{\sqrt{3} F_6 F_7 F_8 p h \ell}{2 R_{eH}} 10^4$$

where:

h : Height, in m, of load area defined in [2.4.4], without the product ph being taken less than 0,15

m_S : Boundary condition coefficient for the ordinary stiffener considered, to be taken equal to 13,3 for a continuous beam; where the boundary conditions deviate significantly from those of a continuous beam, e.g. in an end field, a smaller boundary condition coefficient may be required. In such a case, for girders without brackets, a value of m = 11,0 is to be used.

F_6 : Factor that takes account of the distribution of load to the transverse frames, to be taken equal to:

- for ice stringers within the ice belt, $F_6 = 0{,}90$
- for ice stringers outside the ice belt
  $F_6 = 0{,}80\ (h_S / \ell_S)$

F_7 : Factor that takes into account the design point of girders to be taken equal to 1,8

F_8 : Factor that takes into account the maximum shear force versus load location and the shear stress distribution to be taken equal to 1,20

h_S : Distance to the ice belt as defined in Tab 2, in m

ℓ_S : Distance to the adjacent ice stringer, in m .

2.5.7 Vertical primary supporting member checked through simplified model

For vertical primary supporting members which may be represented by the structure model represented in Fig 3, the section modulus w, in cm³, and the effective shear area A_{Sh}, in cm², are to be not less than the values obtained from the following formulae:

$$w = \frac{M}{R_{eH}}\left(\frac{1}{1 - (\nu A_{Sh1}/A_a)^2}\right)^{\frac{1}{2}} 10^3$$

$$A_{Sh} = 10\frac{\sqrt{3} F_9 \alpha Q}{R_{eH}}$$

where:

F : Load transferred to a vertical primary supporting member from a stringer or from longitudinal ordinary stiffeners, to be obtained, in kN, from the following formula:

$F = F_{10}\ p\ h\ s\ 10^3$

F_{10} : Factor that takes into account the design point of girders to be taken equal to:

- for vertical primary supporting members within the ice belt, $F_{10} = 1,80$
- for vertical primary supporting members outside the ice belt,

  $F_{10} = 1,80\ (1 - h_S / \ell_S)$, where h_S and ℓ_S are to be taken as defined in [2.5.6]

F_9 : Factor that takes into account the shear force distribution to be taken equal to 1,1

Q : Maximum calculated shear force, in kN, under the ice load F

M : Maximum calculated bending moment, in kN.m, under the ice load F to be taken equal to $M = 0,193\ F\ell$

ν : Coefficient defined in Tab 6

α : Coefficient defined in Tab 6

p : Design ice pressure, in N/mm², defined in [2.4.5], where the value of c_a is to be calculated assuming ℓ_a equal to 2S

S : Distance between web frames, in m

h : Height, in m, of load area defined in [2.4.4], without the product ph being taken less than 0,15

A_{Sh1} : Required shear area, in cm²

A_a : Actual cross-sectional area, in cm² of the vertical primary supporting member, to be taken equal to $A_F + A_W$.

Figure 3 : Reference structure model

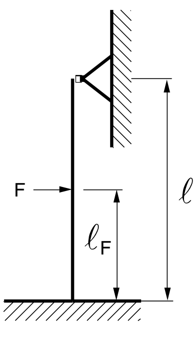


Table 6 : Coefficients α,ν

A_F/A_W	α	ν
0,20	1,23	0,44
0,40	1,16	0,62
0,60	1,11	0,71
0,80	1,09	0,76
1,00	1,07	0,80
1,20	1,06	0,83
1,40	1,05	0,85
1,60	1,05	0,87
1,80	1,04	0,88
2,00	1,04	0,89

Note 1:
A_F : Cross-sectional area of the face plate
A_W : Cross-sectional area of the web.

2.6 Side scuttles

2.6.1 Sidescuttles are to be not located in the ice strengthened area.

3 Miscellaneous requirements

3.1 River water inlets and cooling water systems of machinery

3.1.1

a) The cooling water system is to be designed to ensure the supply of cooling water also when operating in ice.

b) For this purpose, at least one river water inlet chest is to be arranged and constructed as indicated hereafter:

   1) The river water inlet is to be situated near the centreline of the unit.
   2) The chest is to be sufficiently high to allow ice to accumulate above the inlet pipe.
   3) A pipe for discharging the cooling water, having the same diameter of the main overboard discharge line, is to be connected to the inlet chest.
   4) The area of the strum holes is to be not less than 4 times the inlet pipe sectional area.

c) Where there are difficulties in satisfying the requirements of b.3) above, two smaller chests may be accepted, alternatively, provided that they are located and arranged as stated in the other provisions above.

d) Heating coils may be installed in the upper part of the chests.

SECTION 5 POLLUTION PREVENTION (CLEAN-UNIT)

1 Scope and application

1.1 General

1.1.1 This Section contains the requirements for the prevention of water and air pollution.

1.1.2 Additional class notations for the prevention of water and air pollution include:

- **Clean-unit**
- other notations having a specific scope.

The relevant symbol, scope, reference to the Rules and assignment conditions are given in Tab 1.

Examples of notations are given below:

- **Clean-unit**
- **OWS-5 ppm**
- **AWT**, **NDO-2 days**

1.1.3 Requirements for onboard surveys are given in [11] and Pt A, Ch 3, Sec 2, [5].

1.2 Applicable Rules and Regulations

1.2.1 Additional requirements may be imposed by the competent Authorities, in particular with respect to:

- exhaust gas smoke (particulate emissions, smoke opacity)
- fuel oil sulphur content
- bilge water oil content
- on board waste incineration.

2 Definitions and abbreviations

2.1 Definitions related to water pollution

2.1.1 Hazardous wastes

Hazardous wastes are those wastes composed of substances which are identified as water pollutants according to recognised standards.

Hazardous wastes include in particular:

- photo processing chemicals
- dry cleaning waste
- used paints
- solvents
- heavy metals
- expired chemicals and pharmaceuticals
- waste from printers
- hydrocarbons and chlorinated hydrocarbons
- used fluorescent and mercury vapour light bulbs
- batteries.

Note 1: Empty packagings previously used for the carriage of hazardous substances are to be considered as hazardous substances.

2.1.2 Wastewater

Wastewater includes both sewage and grey water defined hereunder.

Table 1 : Additional class notations for the prevention of pollution

Symbol	Scope	Reference to the Rules	Assignment conditions
Clean-unit	Prevention of water and air pollution	[4]	
AWT	Fitting of an Advanced Wastewater Treatment plant	[5]	
GWT	Fitting of a treatment installation for Grey Waters	[6]	
NDO-x days	The vessel is designed for No Discharge Operation during x days	[7]	
NOX-x%	Average NOx emissions of engines not exceeding x% of limit	[8]	
OWS-x ppm	Fitting of an Oily Water Separator producing effluents having a hydrocarbon content not exceeding x ppm (parts per million)	[9]	
SOX-x%	Oil fuels have a sulphur content not exceeding x% of the relevant limit	[10]	As an alternative, equivalent arrangements (e.g. exhaust gas cleaning systems) may be accepted

2.1.3 Sewage

Sewage means:

- drainage and other wastes from any form of toilets, urinals, and WC scuppers, here designated as black waters
- drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises
- drainage from spaces containing live animals, or
- other waste waters when mixed with the drainages defined above.

2.1.4 Sewage sludge

Sewage sludge means any solid, semi-solid, or liquid residue removed during the treatment of on-board sewage.

2.1.5 Grey water

Grey water includes drainage from dishwashers, showers, sinks, baths and washbasins, laundry and galleys.

2.1.6 Garbage

Garbage means all kinds of victual, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the unit.

Garbage includes all kinds of solid wastes like plastics, paper, oily rags, glass, metal, bottles, and incinerator ash. Food wastes are considered as garbage.

2.1.7 Oil residue (sludge)

Oil residue (sludge) means the residual waste oil products generated during the normal operation of a unit such as those resulting from the purification of fuel or lubricating oil, separated waste oil from oil filtering equipment, waste oil collected in drip trays, and waste hydraulic and lubricating oils.

2.1.8 Oil residue (sludge) tank

Oil residue (sludge) tank means a tank which holds oil residue (sludge) from which sludge may be disposed directly through the standard discharge connection or any other approved means of disposal.

2.1.9 Oily bilge water

Oily bilge water means water which may be contaminated by oil resulting from things such as leakage or maintenance work in machinery spaces. Any liquid entering the bilge system including bilge wells, bilge piping, tank top or bilge holding tanks is considered oily bilge water.

2.1.10 Oily bilge water holding tank

Oily bilge water holding tank means a tank collecting oily bilge water prior to its discharge, transfer.

2.1.11 Oily wastes

Oily wastes means oil residues (sludge) and oily bilge water.

2.1.12 Advanced Wastewater Treatment (AWT)

Any treatment of wastewater that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. AWT water effluent standard corresponds to the technology currently available for municipal wastewater treatment plants.

2.1.13 Accidental discharge

All discharge to water caused by unforeseen or accidental events, such as damage to the unit or its equipment, and including discharge necessary for the purpose of protection of the unit or saving life.

2.1.14 No discharge condition

Condition without discharge of hazardous wastes, treated and untreated wastewater, oily wastes or garbage into the water.

Note 1: Where the **AWT** notation is assigned to the unit, the discharge of treated sewage and treated grey water is allowed.

Note 2: In the “No discharge condition”, no effluents from exhaust gas cleaning systems may be discharged into the water.

2.2 Definitions related to air pollution

2.2.1 Emission

Emission means any release of substances from units into the atmosphere or water.

2.2.2 Ozone depleting substances

Ozone-depleting substances means controlled substances defined in paragraph (4) of article 1 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.

Ozone-depleting substances that may be found on board unit include, but are not limited to:

- Halon 1211 Bromochlorodifluoromethane
- Halon 1301 Bromotrifluoromethane
- Halon 2402 1,2-Dibromo-1,1,2,2-tetrafluoroethane (also known as Halon 114B2)
- CFC-11 Trichlorofluoromethane
- CFC-12 Dichlorodifluoromethane
- CFC-113 Trichloro-1,2,2-trifluoroethane
- CFC-114 1,2-Dichloro-1,1,2,2-tetrafluoroethane
- CFC-115 Chloropentafluoroethane.

2.2.3 Onboard incineration

On board incineration means the incineration of wastes or other matter on board a unit, if such wastes or other matter were generated during normal operation of that unit.

2.2.4 Onboard incinerator

Onboard incinerator means an onboard facility designed for the primary purpose of incineration.

2.2.5 Exhaust gas smoke

Exhaust gas smoke is a visible suspension of solid and/or liquid particles in gases resulting from combustion or pyrolysis.

Note 1:

- Black smoke (soot) is mainly comprised of carbon particles
- blue smoke is usually due to droplets resulting from the incomplete combustion of fuel or lubricating oil
- white smoke is usually due to condensed water and/or liquid fuel
- yellow smoke is caused by NO_2.

2.3 Abbreviations

2.3.1 AWT

AWT means advanced wastewater treatment.

2.3.2 EGC

EGC means exhaust gas cleaning.

2.3.3 OWS

OWS means oily water separator.

3 Documents to be submitted and applicable standards

3.1 Documents to be submitted

3.1.1 Certificates

The certificates to be submitted prior to the delivery of the additional class notations **Clean-unit** and other notations are listed in Tab 2.

3.1.2 Operational procedures

The operational procedures to be submitted are listed in Tab 3.

3.1.3 Plans and documents

The plans and documents to be submitted are listed in Tab 4.

3.2 Modifications and additions

3.2.1 In case of modifications or additions to the approved installations, arrangements or procedures, the relevant details are to be submitted for review/approval.

4 Design requirements for the additional class notation Clean-unit

4.1 Waste management

4.1.1 Waste generation

The waste quantities to be considered for the calculation of:

- the volume of the holding tanks
- the capacity of the waste treatment and storage equipment

are to be derived from the experience gained on similar types of units operated in similar conditions. Where no data are available, the figures listed in Tab 5 are to be used.

Table 2 : Required certificates

Notations	Certificate	Applicable Rules and Regulations
Clean-unit	Type approval certificate of the sewage system	IMO Resolution MEPC.159(55)
	Type approval certificate of the incinerator **(1)**	• IMO Resolution MEPC.76(40) as amended by Resolution MAPC.93(45) • Annex VI of MARPOL 73/78, Appendix IV
	Type approval certificate for new engines **(2)**	
	SOx emission compliance certificate Certificate of unit approval for exhaust gas cleaning system **(3)**	IMO Resolution MEPC.184(59), Appendix I
	IAFS certificate or Declaration on Anti-fouling system	International Convention on the control of Harmful and Anti-fouling systems, 2001, Annex 4, Appendices 1and 2
AWT	Type approval of the AWT plant	Article [5]
GWT	Type approval certificate of the grey water treatment plant	Article [6]
NDO-x days	N/R	
NOX-x%	Type approval certificate for new engines **(2)**	Article [8]
OWS-x ppm	Type approval certificate of the oily water separator with indication of “x ppm” performance	Article [9]
SOX-x%	Type approval certificate of the exhaust gas cleaning system **(3)**	Article [10]

(1) Onboard incinerator is not required. However, when fitted on board, it is to be type-approved.
(2) Type approval certificate may include a NOx-reducing device as a component of the engine.
(3) Where such an equivalent arrangement is provided.
Note 1: N/R = not required

Table 3 : Required operational procedures

Notations	Operational procedure	Applicable Rules and Regulations
Clean-unit	Onboard oil pollution plan **(1)**	IMO Resolution MEPC.54(32) as amended by Resolution MEPC.86(44)
	Procedure to prepare and maintain an oil record book	–
	Bunkering procedure	–
	Measures to prevent oil pollution	–
	Sewage and grey water management plan and discharge control plan **(1)**	IMO Resolution MEPC.157(55)
	Garbage management plan including procedures to prepare and maintain a garbage record book and hazardous waste procedures **(1)**	• IMO Resolution MEPC.70(38) • IMO Circular MEPC/Circ.317 • IMO Resolution MEPC.92(45)
	Operating procedure to be followed to minimise the risk and the consequences of ozone-depleting refrigerant leakage, under normal and emergency conditions, including **(2)**: • checking of the piping tightness • recharge • detection of leakage maintenance and repair	–
	Procedure to prepare and maintain the ozone-depleting substances record book **(2)**	–
	NOx emission control plan	–
	Fuel oil quality management plan	IMO Resolution MEPC.182(59)
	Where an exhaust gas cleaning (EGC) system is used: • SOx emission compliance plan • Onboard monitoring manual • Procedure to prepare and maintain the EGC record book	IMO Resolution MEPC.184(59)
AWT	Wastewater management plan and discharge control plan	–
GWT	Grey water management plan and discharge control plan	–
NDO-x days	Management and storage plan for liquid effluents and solid waste in case of no-discharge operation	–
NOX-x%	NOx emissions control plan	–
OWS-x ppm	Performance monitoring plan for the oily water separator	–
SOX-x%	SOx emissions control plan	–

(1) Only where required by MARPOL 73/78 Convention, according to the unit's maximum displacement.
(2) Only where ozone-depleting substances are used on board.

4.1.2 Separation of waste streams

Design arrangements and procedures for collecting, sorting, treating, storing and discharging solid and liquid waste and harmful substances are to be such that the discharge or discharge prohibition criteria can be fulfilled.

Generally, this implies that the following categories of wastes are separated before any treatment or storage:

- products containing hazardous substance, as defined in [2.1.1]
- plastics, which have to be separated from wastes ultimately discharged to river (sewage or food wastes for instance)
- sewage, including drainage from medical premises, which has to be collected separately from grey water, except if a common treatment installation is installed on board.

Note 1: This does not preclude the mixing of effluents after treatment (e.g. treated sewage mixed with grey water).

Note 2: When water is mixed with wastewater (e.g. for the purpose of washing the holding tanks), the discharge requirements for the wastewater apply to the resulting mixture.

Note 3: When categories of wastewater having different discharge requirements are mixed together, the most stringent requirements apply to the resulting mixture.

Table 4 : Required plans and documents

Notation	Documents	Approval status
Clean-unit	General:	
	• general arrangement plan with indication of the waste collection and conveying circuits, storage means and treatment installations intended for the prevention of pollution by oil, sewage, grey waters, garbage and hazardous packaged substances	I
	• capacity plan	I
	• program for a waste source reduction, minimization and recycling	A
	Prevention of pollution by oil:	
	• diagram of the oil residue (sludge) system,	I
	• diagram of the independent clean drain system, where provided	I
	• diagram of the oily bilge system (pumping, treatment, discharge)	I
	• details of the bilge water holding tank	A
	• calculation of the bilge water holding tank capacity	A
	Prevention of pollution by sewage and wastewater:	
	• diagram of the grey water system (collection, treatment, discharge)	I
	• diagram of the sewage system (collection, treatment, discharge)	I
	• details of the sewage holding tank and grey water holding tank	A
	• calculation of the sewage holding tank and grey water holding tank capacity	A
	• description of the sewage treatment plant or comminuting/disinfecting system	I
	Prevention of pollution by garbage:	
	• general information on the equipment intended for collecting, storing, processing and disposing of garbage (except where type-approved)	I
	• calculation of the necessary storing, processing and disposing capacities	A
	• diagram of control and monitoring systems for garbage handling equipment	A
	Prevention of pollution by oil spillage and leakage:	
	• diagram of the fuel oil and lubricating oil overflow systems	A
	• diagram of the fuel oil and lubricating oil filling, transfer and venting systems	I
	• arrangement of the fuel oil and lubricating oil spillage containment systems	A
	• diagram of the control and monitoring system for fuel oil filling, transfer and overflow systems	I
	Prevention of oil pollution in case of collision or stranding:	
	• arrangement of the fuel oil tanks, lubricating oil tanks and sludge tanks with indication of the volume and of the distance between the tank and the unit base line/unit shell side	I
	Prevention of pollution by anti-fouling systems:	
	• specification of antifouling paint	A
AWT	• diagram of the grey water system (collection, treatment, discharge)	I
	• diagram of the sewage system (collection, treatment, discharge)	I
	• details of the sewage holding tank and grey water holding tank	A
	• calculation of the sewage holding tank and grey water holding tank capacity	A
	• description of the Advanced Wastewater Treatment (AWT) plant and relevant operating principles	I

Note 1:
I = to be submitted for information
A = to be submitted for approval
A/I = to be submitted for approval or information, in accordance with the relevant Rules or Rule Note.
Note 2: Diagrams are to include information about monitoring and recording of parameters.

Notation	Documents	Approval status
GWT	• diagram of the grey water system (collection, treatment, discharge) • details of the grey water holding tank • calculation of the grey water holding tank capacity • description of the grey water treatment plant and relevant operating principles	I A A I
NDO-x days	Calculation of the storage capacity for solid wastes and liquid effluents	A
NOX-x%	• calculation of the weighted average NOx emission level of the unit • calculation of the weighted average NOx emission limit of the unit	A A
OWS-x ppm	Description of the OWS plant and relevant operating principles	I
SOX-x%	Where low sulphur fuel oils are used: • diagram of the fuel oil supply systems • change-over procedure Where an exhaust gas cleaning system is fitted: • washwater diagram • description of the system and relevant operating principles	 I I A I
Note 1: I = to be submitted for information A = to be submitted for approval A/I = to be submitted for approval or information, in accordance with the relevant Rules or Rule Note. **Note 2:** Diagrams are to include information about monitoring and recording of parameters.		

Table 5 : Waste generation quantities

N°	Type of Waste	Unit	Quantities for		
			Hotel	Units with berths	Units without berths
1	Plastics	kg/person/day	0,1	0,1	0,1
2	Paper and cardboard	kg/person/day	1,0	1,0	1,0
3	Glass and tins	kg/person/day	1,0	1,0	1,0
4	Food wastes	kg/person/day	0,7	0,7	0,7
5	Total garbage (1 + 2 + 3 + 4)	kg/person/day	2,8	2,8	2,8
6	Black water	litres/person/day	12 for a vacuum system 100 for a conventional flushing system		
7	Grey water (excluding laundry and galley)	litres/person/day	160	150	50
8	Laundry	litres/person/day	80	20	20
9	Galley	litres/person/day	90	30	30
10	Total grey water (7 + 8 + 9)	litres/person/day	330	200	100

4.1.3 Incineration

Although incineration is possible, storage and subsequent discharge reception facilities is to be given first priority.

Except otherwise stated in this Article, storage arrangements are to be provided for all kinds of liquid and solid wastes, with a capacity corresponding to one day operation of the unit.

Note 1: The attention is drawn to the specific requirements imposed by certain Authorities which may restrict or prohibit waste discharge and/or incineration in the waters under their jurisdiction.

4.2 Oily wastes

4.2.1 Bilge water holding tank

All machinery space bilges and spaces containing hydraulic equipment have to be drained into a bilge water holding tank before separation and oil filtration or discharge ashore. This bilge holding tank is to be separate and independent from the sludge tanks.

Freshwater drains not contaminated by oil may be discharged overboard.

The bilge water holding tank is to have a capacity that provides to the unit the flexibility of operation without the need to discharge de-oiled water overboard. The minimum capacity of the bilge water holding tank is not to be less than the greater of the two following values (in m^3):

- 0,075 S, where S is the surface of the vertical projection, in m^2, of the largest machinery space drained into the bilge holding tank
- the value calculated from Tab 6.

For units operating with heavy fuel oil having a relative density greater than 0,94 at 15°C, the bilge water holding tank is to be fitted with heating facilities.

The bilge water holding tank is to be arranged so as to facilitate the separation of any oil (or oil emulsions resulting from the use of bilge cleaning agents) from the bilge water and the removal of accumulated sediments.

The sludge transfer pump is to discharge either to the standard discharge connection or to the unit's incinerator system.

Note 1: The attention is drawn to the specific requirements imposed by certain Authorities.

Table 6 : Minimum capacity of the bilge water holding tank according to installed power

Installed power (kW)	Capacity (m^3)
up to 1000	1,5
above 1000	1,5 + (P – 1000) / 1500

4.2.2 Oil residue (sludge) tanks

Oil residue (sludge) may be disposed of directly from the oil residue (sludge) tanks through any approved means of disposal.

Note 1: The attention is drawn to the specific requirements imposed by certain Authorities.

4.2.3 Overboard discharges from the bilge pumping system

The overboard discharge valve of any bilge overboard discharge line, unless passing through the 15 ppm bilge separator, is to be kept shut and provided with lead-sealing arrangements.

4.2.4 Segregation of oil and water ballast

No ballast water is to be carried in any fuel oil or lubricating oil tank.

4.2.5 Discharge records

Provisions are to be made to record the following parameters related to the oily water discharge:

- date and time of the discharge
- quantity and oil content of oily water discharged.

4.3 Wastewaters

4.3.1 Design and arrangement of the sewage and grey water systems

The unit is to be fitted with a sewage and a grey water system designed and arranged as follows:

- An approved sewage treatment plant or sewage comminuting and disinfecting system is to be provided.
- A tank is to be provided for the storage of untreated or treated sewage with a capacity complying with [4.3.2].
- A tank is to be provided for the storage of grey waters with a capacity complying with [4.3.2].
- Grey water from galleys is to be collected separately from other grey waters and led through a grease trap prior to additional treatment, storage or discharge.

Note 1: Treated sewage and grey water holding tanks may be combined together.

4.3.2 Holding tanks

Holding tanks for sewage and grey water are to have a capacity sufficient for 24 hours operation of the unit, having regard to the maximum number of persons on board, the daily production of wastewater given in Tab 5 and other relevant factors.

The holding tanks are to be efficiently protected against corrosion and fitted with a level indicator and a high level alarm.

4.3.3 Sewage treatment plants and piping

Sewage treatment plants are to be of a type approved in accordance with the provisions of IMO Resolution MEPC.159(55).

Provisions are to be made in the design for easy access points for the purpose of obtaining representative influent and effluent samples.

Plastic garbage is to be separated from sewage and/or grey water before entering the treatment unit.

For sewage and grey water piping system, refer to Pt C, Ch 1, Sec 4, [3].

4.3.4 Sewage sludges

Sludges from sewage treatment are to be collected and stored then discharged ashore or, where permitted, incinerated onboard.

Where provided, incineration devices are to completely burn the sludges to a dry and inert ash and not to discharge fly ash, malodors or toxic substances.

The capacity of the sewage sludge tanks is to be calculated taking into consideration:

- the maximum period foreseen for sludge discharge ashore, or
- the incinerator capacity and whether incineration is permitted in the areas where the unit is intended to operate.

Ashes from sludge incineration are to be disposed ashore except where permitted under [4.4.6].

4.4 Garbage and hazardous wastes

4.4.1 Garbage management plan

Procedures for collection, sorting, processing and disposal of garbage are to be available in the garbage management plan.

The garbage management plan is to include procedures in order to make sure that the following hazardous wastes are not mixed with other waste streams:

- photo processing waste (including X-ray development fluid waste)
- dry cleaning waste, containing in particular tetrachloroethylene or perchloroethylene (PERC)
- printing materials, like inks, except soy based, non chlorinated hydrocarbon based ink products
- laser printer toner cartridges
- unused and outdated pharmaceuticals
- fluorescent / mercury vapour bulbs
- batteries
- used cleaners, solvents, paints and thinners
- products containing metals such as lead, chromium, copper, cadmium and mercury.

4.4.2 Handling of hazardous waste

Hazardous wastes are to be collected and stored in separate leakproof containers prior to disposal ashore. The storage capacity is to be sufficient for the intended production. The contents of all containers are to be clearly marked.

Note 1: Waste fluids associated with photo processing, including X-ray development, may be treated to remove silver for recycling. The effluent from the recovery unit may be led to the grey water provided it contains less than 5 part per million (ppm). The residues from the recovery unit are to be landed ashore for disposal or recycling.

4.4.3 Collection of garbage

Garbage bins are to be placed at suitable places and within a suitable distance in accommodation spaces and open decks.

Hazardous wastes, plastics and food contaminated wastes are to be collected separately from other wastes.

4.4.4 Storage of garbage

The unit is to have sufficient capacity to store all kinds of garbage produced during one day, taking into account the daily waste generation figures given in [4.1.1] and the values of density given inTab 7.

If incineration is permitted in the areas where the unit is intended to operate, the needed capacity for wastes other than glass and tins may be reduced by 40%, without being less than the needed volume corresponding to one day.

Table 7 : Waste density

Type of waste	Density (kg/m^3)	
	compacted waste	uncompacted waste
Glass, tin	1600	160
Paper, cardboard, plastic	410	40

4.4.5 Food wastes

Arrangements are to be made to store food wastes prior to discharge to reception facilities.

The onboard storage capacity is to be sufficient for one day food waste production, taking into account the figures given in [4.1.1].

4.4.6 Incinerators

Where fitted, incinerators are to be type-approved by the Society, designed and constructed according to the requirements of MEPC.76(40), as amended by MEPC.93(45).

Proper hazardous waste management procedures including segregating hazardous wastes should be instituted onboard each unit to assure hazardous wastes are not introduced into the incinerator. In particular, batteries should be removed from any waste that will be incinerated onboard.

Ashes containing toxic or heavy metal residues are to be kept on board in a suitable container and landed ashore for disposal. Other ashes may be discharged in water where permitted.

Note 1: Ashes are considered as free from toxic or heavy metal residues when metal analysis show that the limit concentrations given in Tab 8 are not exceeded.

Table 8 : Limit concentrations of toxic and heavy metals substances in ashes

Substance	Limit concentration (ppm)
Arsenic	0,3
Barium	4,0
Cadmium	0,3
Chromium	5,0
Lead	1,5
Mercury	0,01
Selenium	0,3
Silver	0,2

4.5 Hull antifouling systems

4.5.1 Compliance with IMO AFS Convention

Units granted with the additional class notation **Clean-unit** have to comply with the relevant requirements of IMO Convention on the Control of Harmful Anti-fouling Systems on vessels, 2001, requiring the complete prohibition of organotin compounds which act as biocides in anti-fouling systems.

4.5.2 Type-approval of anti-fouling systems

Anti-fouling paints are to be of a type approved by the Society, on the basis of the following criteria:

- the product is to be TBT-free
- small quantities of organotin compounds acting as a chemical catalyst are allowed provided their concentration does not exceed 2500 mg total tin per kg of dry paint.

4.6 Prevention of pollution by oil spillage and leakage

4.6.1 Overflow systems

All fuel and lubricating oil tanks the capacity of which exceeds 10 m^3 are to be fitted with an overflow system and a high level alarm or a flow alarm in the overflow system. The alarm signal is to be given where the person in charge of the bunkering or transfer operation will normally be located.

Note 1: The overflow system is to comply with the provisions of Pt C, Ch 1, Sec 4, [4.3].

4.6.2 Containment systems

On the weather and superstructure decks, each fuel or lubricating oil tank vent, overflow and fill pipe connection and each other area where oil spillage may occur is to be fitted with a fixed deck container or enclosed deck area with a capacity of:

- 80 litres if the maximum displacement of the unit is between 300 and 1600 tons
- 160 litres if the maximum displacement of the unit is greater than 1600 tons.

The deck container or area is to be fitted with a closed drainage system.

A seven-barrel spill kit containing the following is to be available on board, ready to be used during bunkering operation:

- sorbents sufficient to absorb seven barrels of oil
- non-sparking hand scoops, shovels and buckets
- portable containers suitable for holding seven barrels of recovered solid waste and seven barrels of recovered liquid waste
- a minimum of 60 litres of a deck cleaning agent
- appropriate protective clothing to protect personnel from inhalation hazards, eye exposure and skin contact
- non-sparking portable pumps with appropriate hoses.

4.6.3 Oily condensates from venting pipes

Venting pipes from machinery spaces and containing hydrocarbon vapours are to be led to a venting box provided with a draining pipe connected to a suitable oily drain tank.

4.7 Refrigeration systems

4.7.1 Application

The following requirements apply to the unit centralized refrigerating plants, centralized air conditioning plants and gas reliquefaction plants.

They do not apply to the refrigeration facilities intended for the storage of the galley supplies and to the air conditioning plants for limited parts of the unit, such as the control stations.

4.7.2 Acceptable refrigerants

The use of halogenated substances as refrigerant is prohibited, with the exception of hydrochlorofluorocarbons (HCFCs), which are permitted until 1 January 2020.

4.7.3 Retention facilities

Refrigeration systems are to be fitted with retention facilities having the capability to retain all the refrigerants, should the necessity to evacuate the whole plant arise in an emergency. The retention facilities may be tanks for liquid media and/or bottles for gaseous media. If only tanks for liquid are used as retention facilities, one or more compressors having the combined capacity to discharge completely the medium from the system into the tanks are to be installed.

4.7.4 Prevention of leakage

Refrigeration systems are to be designed in such a way as to minimise the risk of medium release in the case of maintenance, repair or servicing. Arrangements are to be made to isolate those sections which are to be serviced by a system of valves and by-passes, in such a way as not to stop the operation of the plant, while in service, preventing the risk of release of the medium outside of the plant.

Means are to be provided to avoid the possibility of leak to the atmosphere of the refrigerants or its vapours in any case of failure of the plant.

A warning instruction plate stating that deliberate emissions of halogenated substances is prohibited is to be displayed in the vicinity of the units and of the releasing devices.

4.7.5 Leak detection

The spaces where the medium might be likely to leak are to be continuously monitored by appropriate leak detectors, which are to be of a type approved by the Society.

4.7.6 Alarm

Any detection of medium leak is to activate an audible and visible alarm in a normally manned location. The alarm is to be activated when the concentration of refrigerating or fire extinguishing medium reaches a value agreed with the Society on a case by case basis.

4.8 Fire-fighting systems

4.8.1 Acceptable fire-fighting media

The use of halon and halocarbons media in the fixed and portable fire fighting equipment is prohibited.

4.8.2 Design requirements for fire-fighting systems

Provisions are to be made for the safe containment and disposal of fire-fighting media in case of spillage during maintenance or repair.

4.9 Emission of nitrogen oxides (NOx)

4.9.1 Application

The following requirements apply to all diesel engines, independently of the service, with a rated power of more than 130 kW, installed on the unit, with the exceptions of:

- emergency diesel engines and any other diesel engines intended to be used solely in an emergency situation, independently of their rated power
- engines which are subject to alternative measures for limiting NOx emission, under special consideration of the Society.

Note 1: NOx emissions from gas only engines, boilers and incinerators are not subject to these requirements.

4.9.2 NOx certification of engines

Prior to installation onboard the unit, new engines have to be NOx-certified in accordance with the relevant provisions of the NOx limit for the intended application. A valid type approval certificate (or statement of compliance) is normally to be issued by the Society.

4.9.3 NOx reduction methods

Where NOx reduction methods (such as water injection, fuel oil emulsification, charge air humidification, exhaust gas after-treatment) are used, they are to be approved by the Society and taken into account in the type approval certificate of the engine.

The measurement of NOx emission levels, where required for the control of the reduction process (e.g. to adjust the injection rate of the reduction agent for SCR systems), is to be carried out by means of type-approved analysers.

4.10 Emission of sulphur oxides (SOx)

4.10.1 Use of low sulphur fuel oils

Arrangements are to be made to record the following parameters:

- volume of fuel oil in each tank
- date and time when the fuel change-over operation is completed or started.

4.10.2 Use of exhaust gas cleaning systems

Exhaust gas cleaning (EGC) systems, which may be accepted as an arrangement equivalent to the use of low sulphur fuel oils are to be approved in accordance with IMO Resolution MEPC.184(59): 2009 Guidelines for exhaust gas cleaning systems.

EGC systems are to be fitted with data measuring, recording and processing devices in accordance with the aforesaid Resolution.

The discharge washwater is to satisfy the criteria given in the aforesaid Resolution.

Washwater treatment residues generated by the EGC unit are to be stored in a holding tank having a capacity sufficient for the operation of the unit, then delivered ashore to adequate reception facilities. Such residues are not be discharged to the river or incinerated on board.

5 Additional class notation AWT

5.1 Scope

5.1.1 The additional class notation **AWT** applies to units fitted with an advanced wastewater treatment (AWT) plant, capable of treating both sewage and grey waters with an effluent quality complying with [5.3].

Note 1: Effluents from the AWT plant may be reused or recycled only if they comply with a recognised quality standard for potable water.

5.2 Definitions and abbreviations

5.2.1 7-day average

The 7-day average is the arithmetic mean of pollutant parameter values for samples collected in a period of 7 consecutive days.

5.2.2 30-day average

The 30-day average is the arithmetic mean of pollutant parameter values for samples collected in a period of 30 consecutive days.

5.2.3 BOD_5

BOD5 is the 5-day measure of the pollutant parameter biochemical oxygen demand.

5.2.4 Percent removal

The percent removal is a percentage expression of the removal efficiency across a treatment plant for a given pollutant parameter, as determined from the 30-day average values of the raw wastewater influent pollutant concentrations to the AWT plant and the 30-day average values of the effluent pollutant concentrations for a given time period.

5.2.5 SS

SS is the pollutant parameter total suspended solids.

5.3 Design of the AWT plant

5.3.1 Required capacity

The capacity of the AWT plant is to be sufficient for the maximum number of persons onboard, taking into account the sewage and grey water quantities given in [4.1.1].

5.3.2 Effluent quality

The AWT plant is to be so designed that the minimum level of effluent quality complies with the following limits:

a) BOD5
   1) the 30-day average is not to exceed 30 mg/l
   2) the 7-day average is not to exceed 45 mg/l
   3) the 30-day average percent removal is not to be less than 85 percent.

b) SS
   1) the 30-day average is not to exceed 30 mg/l
   2) the 7-day average is not to exceed 45 mg/l
   3) the 30-day average percent removal is not to be less than 85 percent.

c) pH

The effluent values for pH are to be maintained within the limits of 6,0 to 9,0.

d) Fecal coliform

The geometric mean of the samples from the discharge during any 30-day period is not to exceed 20 fecal coliform/100 millilitres (ml) and no more than 10% of the samples may exceed 40 fecal coliform/100 ml.

e) Total residual chlorine

Concentrations of total residual chlorine is not to exceed 10,0 micrograms per litre (μg/l).

5.3.3 Type tests

Advanced Wastewater Treatment plants are to be of a type approved in accordance with IMO Resolution MEPC.159(55), taking into account the following effluent standards:

a) Fecal coliform standard:

The geometrical mean of the fecal coliform count of the samples of the effluent taken during the test period should not exceed 14 coliforms/100 ml M.P.N. (most probable number) as determined by a 5 tube fermentation analysis or an equivalent analytical procedure. In addition, no more than 10% of the number of samples exceed an M.P.N. of 43 coliforms /100 ml.

b) Total suspended solids standard:

The geometrical mean of total suspended solids is not to exceed 10 mg/l.

c) 5-day biochemical oxygen demand (BOD5) standard:

The geometrical mean of BOD5 is not to exceed 20 mg/l.

d) Total nitrogen (TN) standard:

The geometrical mean of TN is not to exceed 10 mg/l.

e) Total phosphorus (TP) standard:

The geometrical mean of TP is not to exceed 1 mg/l.

6 Additional class notation GWT

6.1 Scope

6.1.1 The additional class notation **GWT** applies to units fitted with a grey water treatment system, the effluents from which have a quality complying with [6.2].

Note 1: Effluents from the grey water treatment plant may be reused or recycled only if they comply with a recognised quality standard for potable water.

6.2 Design of the grey water treatment plant

6.2.1 Required capacity

The capacity of the grey water treatment plant is to be sufficient for the maximum number of persons onboard, taking into account the daily production of grey water given in [4.1.1].

6.2.2 Effluent quality

The grey water treatment plant is to be so designed that the minimum level of effluent quality complies with the limits given in IMO Resolution MEPC.159(55).

6.2.3 Type tests

Grey water treatment plants are to be type-approved in accordance with IMO Resolution MEPC.159(55).

7 Additional class notation NDO-x days

7.1 Scope

7.1.1 The additional class notation NDO-x days applies to units having sufficient onboard storage capacity for solid waste and liquid effluents, allowing the fully loaded unit to operate without discharging any substances into the water during x consecutive days (no discharge period).

7.2 Design requirements

7.2.1 The no discharge operation presupposes that, during the no discharge period:

- no incineration is carried out
- no waste nor effluents are discharged into the water.

Note 1: Where the **AWT** notation is assigned to the unit, the discharge of treated sewage and treated grey water is allowed.

Note 2: Discharge of washwaters from exhaust gas clean cleaning (EGC) systems are not allowed during the no discharge operation. The installation of closed loop EGC systems may be considered in this respect.

7.2.2 The storage capacity for each of the following solid and liquid wastes is to be sufficient to allow the no discharge operation of the unit during x days:

- plastics
- paper and cardboard
- glass and tins
- food waste
- sewage
- grey water
- sewage sludges (where applicable)
- bilge water
- oil residues (sludge)
- hazardous wastes
- washwater treatment residues from EGC units (where applicable).

Note 1: Storage capacity is not required for treated sewage and treated grey water when the notation **AWT** is assigned to the unit.

7.2.3 Except otherwise stated, the storage capacities are to be based on:

- the maximum number of persons onboard
- the daily production of solid waste and liquid effluents given in [4.1.1].

7.2.4 The minimum capacity required for the bilge water holding tank is not to be less than x times the capacity given inTab 6.

8 Additional class notation NOX-x%

8.1 Scope

8.1.1 The additional class notation NOX-x% applies to units fitted with diesel engines having a weighted average NOx emission level not exceeding x% of the weighted average limit.

The NOx performance index x is to be ≤ 90.

8.2 Design requirements

8.2.1 General

The diesel engines to be considered are those referred to in [4.9.1].

NOx reducing devices may be considered if they are covered by the type approval certificate of the engine.

8.2.2 Calculation of the weighted average NOx emission level of the unit

The weighted average NOx emission level of the unit $[NOx]_{unit}$,in g/kWh, is to be calculated as follows:

$$[NOx]_{unit} = \frac{\sum_{i=1}^{n} [NOx]_i \cdot P_i}{\sum_{i=1}^{n} P_i}$$

where:

n : Total number of engines installed on the unit

[NOx]i : NOx emission level of each individual engine as per EIAPP certificate (in g/kWh)

Pi : Rated power of each engine (in kW).

8.2.3 Calculation of the weighted average NOx emission limit of the unit

The weighted average NOx emission limit of the unit $[NO_X]_{max}$, in g/kWh, is to be calculated as follows:

$$[NO_X]_{max} = \frac{\sum_{i=1}^{n} [NO_X]_{max,\,i} \cdot P_i}{\sum_{i=1}^{n} P_i}$$

where:

n, Pi : As defined in [8.2.2]

$[NO_X]_{max,\,i}$: Applicable NOx emission limit of each individual engine, in g/kWh, to be taken as follows, depending on the engine rotational speed N:

- 14,4 when N < 130 rpm
- $44.n^{-0.23}$ when 130 < N ≤ 2000
- 7,7 when N > 2000

Note 1: More stringent restrictions may be imposed by National Flag Authorities in certain area.

8.2.4 Calculation of the NOx performance index x

The NOx performance index x is to be calculated as follows:

$$x = \frac{[NOx]_{unit}}{[NO_X]_{max}}$$

where:

$[NOx]_{unit}$: Weighted average NOx emissions for the unit (in g/kWh), as calculated in [8.2.2]

$[NO_X]_{max}$: Weighted average NOx emission limit for the unit (in g/kWh), as calculated in [8.2.3].

9 Additional class notation OWS-x ppm

9.1 Scope

9.1.1 The additional class notation **OWS-x ppm** applies to units fitted with an oily water separator (OWS) capable of producing effluents having a hydrocarbon content not exceeding x ppm.

The OWS performance index x is to be ≤ 10.

Note 1: ppm means parts of oil per million parts of water by volume.

9.2 Design requirements

9.2.1 The OWS is to be type-approved in accordance with the provisions of IMO Resolution MEPC.107(49), for an effluent quality of x ppm.

The bilge alarm and the automatic stopping device are to be efficient for the x ppm limit.

10 Additional class notation SOX-x%

10.1 Scope

10.1.1 The additional class notation **SOX-x%** applies to units using fuel oils with the sulphur content not exceeding x% of the limit 3,5% m/m.

The SOx performance index x is to be ≤ 90.

Alternative arrangements may be accepted if the resulting SOx emission reduction is deemed equivalent to that corresponding to the use of fuel oils with reduced sulphur content.

Note 1: More stringent restrictions may be imposed by National Flag Authorities in certain area.

10.2 Design requirements

10.2.1 Use of fuel oils with reduced sulphur content

Where fuel oils with reduced sulphur content are used, the requirements in [4.10] are to be complied with.

10.2.2 Use of exhaust gas cleaning systems as alternative arrangement

Where exhaust gas cleaning systems are used, they are to be approved for a SOx emission performance corresponding to the use of a fuel oil having a sulphur content of x% of the limit 1,00% m/m (0,1% m/m after 1st January 2015).

Provisions of [4.10.2] for data measuring and recording are to be complied with.

11 Onboard Surveys

11.1 Application

11.1.1 Survey requirements for the additional class notations **Clean-unit**, and other additional class notations listed in Tab 1 are given in Pt A, Ch 3, Sec 2, [5].

This Article contains additional requirements applying to the additional class notations **Clean-unit**.

11.2 Periodical tests and measurements done by the Owner

11.2.1 Purpose

The following tests and measurements, done under the responsibility of the Owner, are intended to demonstrate the effective implementation of the waste management procedures and the constant level over time kept by the quality of the effluents discharged at water.

11.2.2 Initial period - Initial tests

During the first year of commercial operation, the Owner is to proceed with the following measurements and analyses:

- collection of actual on board data's concerning the volume of wastes generation, using the waste streams as defined inTab 6
- analyses of the effluent and waste streams for pollutant concentration, according to the periodicity defined in Tab 9.

11.2.3 Periodical tests after first year of service

The effluents and wastes usually discharged to water are to be periodically sampled and analyzed by a qualified laboratory. The frequency of these tests in a five-year term period is specified inTab 10.

Tab 11 lists the number of occurrences where the pollutant maximum concentration may exceed the limit concentration specified in Tab 8 and Tab 12 without exceeding the reject value.

Test results of the measurements are to be recorded in the wastewater and garbage logbooks and made available to the surveyor during the periodical surveys.

11.2.4 Water effluent standard

The effluent standard for biological analyses of waters are given in Tab 12.

11.2.5 Metals analyses

The analyses given in Tab 8 are to qualify the incinerator ash and grey water as free from hazardous wastes. The metals listed in Tab 8 are considered as indicators of toxicity.

11.3 Periodical surveys

11.3.1 Initial survey Tests

After installation on board, the equipment and systems relevant to the requirements of the present Section are to be tested in the presence of the Surveyor under operating conditions. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor or their functioning is to be simulated according to a procedure agreed with the Society.

11.3.2 Periodical survey

The annual and class renewal surveys are to be carried out in accordance with the provisions of Pt A, Ch 3, Sec 2, [5.2].

Table 9 : Frequency of analyses of waste streams during the first year of service

Waste stream	Frequency of analyses
Metals analyses in incinerator ash **(1)**	quarterly
Metals analyses in grey water	quarterly
Effluent analyses sewage treatment plan	yearly
Effluent analyses for Advanced Wastewater Treatment	quarterly
(1) If the unit is equipped to dump incinerator ash overboard.	

Table 10 : Frequency of analyses of waste streams after the first year of service

Waste stream	Number of analyses in a 5-year period
Metals analyses in incinerator ash **(1)**	2
Metals analyses in grey water	2
Effluent analyses sewage treatment plan	2
Effluent analyses for Advanced Wastewater Treament	20
Oil content analyses of machinery bilge water	2
(1) If the unit is equipped to dump incinerator ash overboard.	

Table 11 : Permissible number of analyses exceeding limit values

Number of analyses in a 5-year period	Maximum number of analyses above limit
2-5	0
20	3

Table 12 : Biological analyses standard for waters

Water to be tested	Pollutant	Limit concentration	Reject value
Effluent of oil filtering equipment	Oil	15 ppm	–
Effluent of sewage treatment plant	Fecal coliform	100 coli/100 ml	–
	Total suspended solids (TSS)	35 mg/l	–
	5-day Biochemical Oxygen Demand (BOD_5)	25 mg/l	–
Effluent of AWT unit (applies only to units having the additional class notation **AWT**)	Fecal coliform	14 coli/100 ml	43 coli/100 ml
	TSS	10 mg/l	25 mg/l
	BOD_5	20 mg/l	30 mg/l
	Total Nitrogen (TN)	10 mg/l	25 mg/l
	Total phosphorus (TP)	1 mg/l	5 mg/l

BELAC

Organisme belge d'Accréditation
Belgische Accreditatieinstelling
Belgische Akkreditierungsstelle
Belgian Accreditation Body

Signatory to EA, ILAC and IAF Multilateral Agreements

Accreditation Certificate No. 440-INSP

In compliance with the provisions of the Royal Decree of 31 January 2006 setting up BELAC, the Accreditation Board hereby declares, that the inspection body

BUREAU VERITAS MARINE BELGIUM & LUXEMBOURG N.V.
DNI - Direction de la Navigation Intérieure
Mechelsesteenweg, 128-136
2018 ANTWERPEN - Belgium

has the competence to perform the inspections as described in the annex which is an integral part of the present certificate, in accordance with the requirements of the standard NBN EN ISO/IEC 17020:2004 (as type A inspection body). The present accreditation is the subject of regular surveillance in order to confirm the compliance with the accreditation conditions.

The Chair of the Accreditation Board BELAC,

Nicole MEURÉE-VANLAETHEM

Issue date : **2011-06-21**

Validity date : **2014-06-20**

Original version of this certificate is in Dutch.

.be

Annex to the accreditation certificate BELAC No. 440-INSP

BUREAU VERITAS MARINE BELGIUM & LUXEMBOURG N.V.
DNI – Direction de la Navigation Intérieure

Version No. 1

Issue date : 2011-06-21

Validity date : 2014-06-20

In the name of the Accreditation Board,
The Chair,

Nicole Meurée-Vanlaethem

BELAC

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E6-0035

Keuringsinstelling type A

LOCATIONS which fall under this accreditation :

- BVMarine DNI offices Antwerp
- DNI survey centre Antwerp

NOMENCLATURE

(1) Bureau Veritas Classification Rules for Inland Navigation Vessels.

Règlement Bureau Veritas pour la Classification des bateaux de navigation intérieure, référence NR217 (dernière version NR217 DNI R03 Avril 2009 & amendements Mars 2010) - Classification d'un bateau neuf ou Maintien de la classification d'un bateau en service

(2) RVBR – ROSR 1995, Règlement de visite des bateaux du Rhin, excepté Art 23, Art 23.09 y compris.

Reglement Onderzoek Schepen op de Rijn, behalve Art 23, Art 23.09 inbegrepen

(3) ADN – Directive 2008/68/CE of 24/09/2008. International Carriage of Dangerous Goods by Inland Waterways – Valid from01/01/2011. Parts 4 and 5 excluded. (Emballages et procédures d'expédition)

(4) Directive 2006/87/CE of 12/12/06 Directive 2006/87/EC laying down technical requirements for inland waterway vessels, except Art 23, Art 23.09 included, Annexes VI et VII excluded

(5) Arrêté Royal du 8 mars 2007 (Belgique) relatif aux bateaux de navigation intérieure qui sont aussi utilisé pour effectuer des voyages non internationaux par la mer.- excepté Article 7 (Stabilité)

Koninklijk Besluit van 8 MAART 2007 (België) betreffende binnenschepen die ook voor niet-internationale zeereizen worden gebruikt. Behalve Artikel 7 (Stabiliteit)

Keuringsinstelling type A

Sector	Type of Assessement	Standards	Location (survey centre)
Inland navigation: newly built ships	Classification	Bureau Veritas Classification Rules for Inland Navigation Vessels. (1)	Antwerp (Belgium)
Inland navigation: newly built ships	Conformity to statutory rules	RVBR (2) ADN - Directive 2008/68 (3) Directive 2006/87 (4) Arrêté Royal du 8 mars 2007 (Belgique) (5)	Antwerp (Belgium)
Inland navigation: ships in service	Classification	Bureau Veritas Classification Rules for Inland Navigation Vessels. (1)	Antwerp (Belgium)
Inland navigation: ships in service	Conformity to statutory rules	RVBR (2) ADN - Directive 2008/68 (3) Directive 2006/87 (4) Arrêté Royal du 8 mars 2007 (Belgique) (5)	Antwerp (Belgium)