TASNEEF
هيئة الإمـــــارات للتصـــنـيـف
EMIRATES CLASSIFICATION SOCIETY

Rules for Certification of Racing Sailing Yachts

Effective from 1 July 2025

Part C

Machinery, Systems and Fire Protection

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EMIRATES CLASSIFICATION SOCIETY

GENERAL TERMS AND CONDITIONS
OF EMIRATES CLASSIFICATION SOCIETY – L.L.C – O.P.C (TASNEEF)
EFFECTIVE AS OF 1 APRIL 2025

DEFINITIONS

Administration	means the government of the state whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.
Client	means the interested party and any other party who requires the Services.
Certificate of Classification	means a certificate of classification, issued by a Society and the certificate confirms that the vessel's structure, machinery, and equipment meet the society's specific technical rules and regulations.
Interested Party	means the party, other than the society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the Ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.
Owner	means the registered owner, the Ship owner, the manager or any other party with the responsibility, legally or contractually, to keep the Ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in part a, chapter 2 of the rules for the classification of Ships or in the corresponding rules indicated in the specific rules.
Register of Ships	means a register book, also known as a Register of Ships, is a comprehensive record of vessels that are classified by a society.
Rules	means the documents below issued by the Society: a. Rules for the classification of Ships or other special units. b. Complementary rules containing the requirements for certification of products, plants, systems and other or containing the requirements for the assignment of additional class notations. c. Rules for the application of statutory rules, containing the rules to perform the duties delegated by administrations. d. Guides to carry out particular activities connected with Services. e. Any other technical document, as for example rule variations or interpretations.

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Services	means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.
Ship	means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.
Society	means Emirates Classification Society LLC OPC and/or its affiliated entities providing the Services.
Surveyor	means technical staff acting on behalf of the society in performing the Services.
UAE	means United Arab Emirates.

ARTICLE 1

1.1 The purpose of the Society is, among others, the classification and certification of Ships and the certification of their parts and components.

1.2 The Society (a) sets forth and develops Rules; (b) publishes the Register of Ships[1]; and (c) issues certificates, statements and reports based on its survey activities.

1.3 The Society also takes part in the implementation of national and international rules and standards as delegated by various Governments.

1.4 The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which is regulated by these general conditions unless expressly excluded in the particular contract.

ARTICLE 2

2.1 The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, though committed, also through its research and development services, to continuous updating, does not guarantee they meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.

2.2 The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatement. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification. The Rules for Classification of Ships are published on the Society's website: www.tasneefmaritime.ae

2.3 The Society exercises due care and skill:

(a) in the selection of its Surveyors; and

(b) in the performance of its Services, taking into account the level of its technical knowledge at the time the

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Services are performed.

2.4 Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of each component of the Ship or of the items subject to certification. The surveys and checks made by the Society, either on board Ships or with remote techniques, do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks to qualified service suppliers, who will carry out these duties under their responsibility. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

ARTICLE 3

3.1 The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflect the discretionary opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).

3.2 The Society is under no obligation to make statements or provide information about elements or facts which are not part of the specific scope of the Service requested by the Interested Party or on its behalf.

3.3 No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as part of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, are governed by the Rules of the Society, whom is the sole subject entitled to make such authentic interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.

3.4 The classification of a Ship, or the issuance of a certificate or other document connected with classification or certification and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaworthiness, structural integrity, quality or fitness for a particular purpose or service of any Ship, structure, material, equipment or machinery inspected or tested by the Society.

3.5 Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certification or other activity at the time of the check.

3.6 The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by

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the Society are in no way intended to replace the duties and responsibilities of other parties including, without limitation, Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

3.7 These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, the Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.

3.8 In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.

3.9 In consideration of the above, and within the limits of liability under Article 5 below, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered, where these are attributable to the Interested Party.

3.10 Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the Services rendered by the Society are described in the Rules applicable to the specific Service rendered.

ARTICLE 4

4.1 Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.

4.2 In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees and costs, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of non-payment of the invoice within the contractually agreed terms, the Society reserves the right to request, in addition to the full payment of the principal amount due and without the need for further formal notice, also:

(a) Late payment interest at a rate of 5% per annum, calculated from the due date of the invoice until full payment is received, in accordance with the applicable laws in the United Arab Emirates or the country from where the invoice is issued. Any applicable VAT, taxes, or statutory levies shall be borne by the Client as per the laws

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of the respective jurisdiction;

(b) full reimbursement of any costs incurred for debt recovery, including, but not limited to, legal fees, administrative expenses, and the costs of any extrajudicial actions; and

(c) any additional amount due as compensation for damages suffered as a result of the delay or non-compliance, where documented.

4.3 The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.

4.4 The Society may withhold, suspend or withdraw any certificate, report or service in the event of non-payment of fees due to any member of the Society by the Client in relation to the entire business relationship between any member of the Society and the Client or by any other companies belonging to the same group as the Client. This also applies when the obligation to pay rests with a builder or with the Ship's previous Owner.

4.5 For every case of termination or suspension of the contract, the fees for the activities performed until the time of the termination or of the suspension shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination or of the suspension.

4.6 With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any statutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

ARTICLE 5

5.1 In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see Article 2), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.

5.2 Therefore, subject to what provided for in Article 5.3 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.

5.3 Notwithstanding the provisions in Article 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific Services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of AED5,000 (Arab Emirates Dirhams Five Thousand only).

5.4 Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the

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performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than AED 300,000 (Three Hundred Thousand Dirhams). Payment of compensation under this Article will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in Article 5.

5.5 Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: THREE MONTHS from the date on which the Services were performed or THREE MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

ARTICLE 6

6.1 Any dispute, controversy, or claim arising out of or relating to these Rules, the Services of the Society, or the interpretation, breach, or termination thereof, shall first be referred to the parties' senior management for amicable resolution within thirty (30) days of written notice by either party.

6.2 If the dispute is not resolved amicably under Article 6.1, it shall be exclusively governed by and construed in accordance with the laws of the Emirate of Abu Dhabi and the applicable federal laws of the United Arab Emirates. The courts of Abu Dhabi shall have exclusive jurisdiction to settle any such dispute.

ARTICLE 7

7.1 All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorisation of the Interested Party, except as provided for or required by any applicable legislation from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.

7.2 Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.

7.3 Notwithstanding the general duty of confidentiality owed by the Society to its clients in Article 7.1 above, the Society's clients hereby accept that the Society will participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the Ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.

7.4 In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file,

as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.

7.5 In the event that the ownership of the Ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which have come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

ARTICLE 8

8.1 The Society shall not be obliged to perform any obligation towards the Client (including, without limitation, obligation to (a) perform, deliver, accept, sell, purchase, pay or receive money to, from or through a person or entity, or (b) engage in any other act) if this would be in violation of, inconsistent with or expose the Society to punitive measures under any United Nations resolutions and/or under any laws, regulations, decrees, ordinances, orders, demands, requests, rules or requirements of EU, United Kingdom, and/or United States of America and which relate to foreign trade controls, export controls, embargoes or international boycotts (applying, without limitation, to the financing, payment, insurance, transportation, delivery or storage of product and/or services) hereinafter referred to as "Trade Sanctions".

8.2 Recurring the above circumstances during the performance of the contract, the Society shall be entitled at its sole and absolute discretion:

(a) to immediately suspend payment or performance of the Services which are the object of the contract until such;

(b) time as the Trading Sanctions are in force;

(c) to a full disengagement from the obligation affected by the Trading Sanctions, in the event that the inability to fulfill the said obligation persists until the term provided for the fulfilment hereunder, provided that where the relevant obligation relates to payments for activities and/or Services which have already been delivered, the affected payment obligation shall remain only suspended until such time as the Trading Sanctions no longer apply to the payment ; and/or

(d) to terminate the contract, without prejudice of the Society's rights pursuant to Article 4.

ARTICLE 9

Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

ARTICLE 10

When the Society provides its Services to a consumer - i.e. a natural person who does not act within the scope of his business or professional activity - the following provisions do not apply Article 3 (as far as the Society is solely entitled to the authentic interpretation of the Rules); Article 4, (as far as the payment of the fees is also due for Services not

concluded due to causes not attributable to the Interested Party); Article 5 (as far as the exclusion of liability is concerned), and Article 6 (as far as the jurisdiction of a Board of Arbitrators based in Abu Dhabi is concerned).

ARTICLE 11

11.1 The Society and the Interested Party shall promote safety, protect human health and environment and create safe working conditions for their personnel.

11.2 The Interested Party shall guarantee that the working environment in which the Society's Surveyor will be required to work is adequate, safe and in all respect compliant with the applicable legislation and Rules and shall adopt all necessary measures to mitigate and/or control any relevant risk.

11.3 Furthermore, in accordance with the applicable legislation and Rules, the Interested Party shall provide the Society with complete and detailed information relevant to any actual or potential specific risk existing in the work areas where the Surveyor will be required to operate and relevant to the performance of the Services as well as with any specific safety measure that the Society's Surveyor is requested to comply with.

11.4 The Society reserves not to commence and/or to suspend the Services and/or to terminate the contract, claiming compensation for any damage occurred, if it considers that the safety requirements listed in this Article are not satisfactorily met.

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RULES FOR CERTIFICATION OF RACING SAILING YACHTS

Part C
Machinery, Systems and Fire Protection

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Chapter 1
MACHINERY

SECTION 1 GENERAL REQUIREMENTS

1 General

1.1 Application

1.1.1 Chapter 1 applies to the design, construction, installation, tests and trials of main propulsion and essential auxiliary machinery systems and associated equipment, pressure vessels, piping systems, and steering and manoeuvring systems installed on board certified yachts, as indicated in each Section of this Chapter.

1.2 Documentation to be submitted

1.2.1 Before the actual construction is commenced, the Manufacturer, Designer or Shipbuilder is to submit to the Society the documents (plans, diagrams, specifications and calculations) requested in the relevant Sections of this Chapter.

The list of documents requested in each Section is to be intended as guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents to those detailed in the Sections, in the case of non-conventional design or if it is deemed necessary for the evaluation of the system, equipment or component.

Plans are to include all the data necessary for their interpretation, verification and approval.

In any case, the Society reserves the rights to require additional information when deemed necessary.

1.3 Definitions

1.3.1 General

In general definitions in TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 1 apply.

2 Design and construction

2.1 General

2.1.1 The machinery and 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 shall 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 Vibrations

2.2.1 Special consideration is to be given to the design, construction and installation of propulsion machinery systems and auxiliary machinery so that any mode of their vibrations shall not cause undue stresses in this machinery in the normal operating ranges.

2.3 Operation in inclined position

2.3.1 Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the yacht are, as fitted in the yacht, be designed to operate when the yacht is upright and when inclined at any angle of list either way and trim by bow or stern as stated in Tab 1.

The Society may permit deviations from angles given in Tab 1, taking into consideration the type, size and service conditions of the yacht.

Machinery with a horizontal rotation axis is generally to be fitted on board with such axis arranged alongship. If this is not possible, the Manufacturer is to be informed at the time the machinery is ordered.

2.4 Ambient conditions

2.4.1 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 each Section of this Chapter.

2.5 Power of machinery

2.5.1 Unless otherwise stated in each Section of this Chapter, where scantlings of components are based on power, the values to be used are determined as follows:

- for main propulsion machinery, the power/rotational speed for which certification is requested
- for auxiliary machinery, the power/rotational speed which is available in service.

2.6 Astern power

2.6.1 Sufficient power for going astern is to be provided to secure proper control of the in all normal circumstances.

Table 1 : Inclination of yacht

Installations, components	Angle of inclination (degrees) **(1)**			
	Athwartship		Fore and aft	
	static	dynamic	static	dynamic
Main and auxiliary machinery	15	22,5	5 (3)	7,5
Safety equipment, e.g. emergency power installations, emergency fire pumps and their devices Switch gear, electrical and electronic appliances (2) and remote control systems	22,5	22,5	10	10
(1) Athwartship and fore-and-aft inclinations may occur simultaneously. **(2)** No undesired switching operations or operational changes are to occur.				

Table 2 : Ambient conditions

AIR TEMPERATURE	
Location, arrangement	Temperature range (°C)
In enclosed spaces	between 0 and +45 **(2)**
On machinery components In spaces subject to higher or lower temperatures	According to specific local conditions
On exposed decks	between -25 and +45 **(1)**

WATER TEMPERATURE	
Coolant	Temperature (°C)
Sea water or, if applicable, sea water at charge air coolant inlet	up to +32
(1) Electronic appliances are to be designed for an air temperature up to 55°C (for electronic appliances see also Chapter 2). **(2)** Different temperatures may be accepted by the Society in the case of s intended for short range.	

For main propulsion systems with reversing gears, controllable pitch propellers or electrical propeller drive, running astern is not to lead to an overload of propulsion machinery.

2.7 Safety devices

2.7.1 Where risk from overspeeding of machinery exists, means are to be provided to ensure that the safe speed is not exceeded.

2.7.2 Where main or auxiliary machinery including pressure vessels or any parts of such machinery are subject to internal pressure and may be subject to dangerous overpressure, means shall be provided, where practicable, to protect against such excessive pressure.

2.7.3 Main internal combustion propulsion machinery and auxiliary machinery shall 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.

See also the specific requirements given in the other Sections of this Chapter.

2.8 Fuels

2.8.1

In general TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 1, [2.8] applies.

2.9 Use of asbestos

2.9.1

New installation of materials which contain asbestos is prohibited.

3 Arrangement and installation on board

3.1 General

3.1.1 Provision shall be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery, including pressure vessels.

Easy access to the various parts of the propulsion machinery is to be provided by means of ladders and gratings fitted with strong and safe handrails.

Spaces/boxes containing main and auxiliary machinery are to be provided with adequate lighting and ventilation.

3.2 Bolting down

3.2.1 Bedplates of machinery are to be securely fixed to the supporting structures.

The same requirements apply to thrust block and shaft line bearing foundations.

Particular care is to be taken to obtain a perfect levelling and general alignment between the propulsion engines and their shafting .

3.3 Safety devices on moving parts

3.3.1 Suitable protective devices are to be provided in way of moving parts (flywheels, couplings, etc.) in order to avoid injuries to personnel.

3.4 Gauges

3.4.1 All gauges are to be grouped, as far as possible, near each manoeuvring position; in any event, they are to be clearly visible.

3.5 Ventilation in machinery spaces/boxes

3.5.1

Machinery spaces are to be sufficiently ventilated so as to ensure that when machinery therein are operating at full power in all weather conditions, including heavy weather, if necessary, an adequate supply of air is maintained to the spaces for the safety and comfort of personnel and 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.The ventilation ducts not led directly to the external spaces are to be fitted with means of closure.

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.

The ventilation is to be so arranged as to prevent any accumulation of flammable gases or vapours.

The requirements of the engine Manufacturer are to be complied with.

3.6 Hot surfaces and fire protection

3.6.1

Surfaces, having temperature exceeding 60°C, 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 turbochargers, are to be effectively insulated with non-combustible material 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.

The insulation of hot surfaces is to be of a type and so supported that it does not crack or deteriorate when subject to vibration.

Fire protection, detection and extinction is to comply with the requirements of Chapter 4.

3.7 Machinery remote control, alarms and safety systems

3.7.1 For remote control systems of main propulsion machinery and essential auxiliary machinery and relevant alarms and safety systems, the requirements of Chapter 3 apply.

SECTION 2 DIESEL ENGINES

1 General

1.1 Application

1.1.1

Diesel engines listed below are to be at least EC marked under EC Craft Directive:

a) main propulsion engines

b) engines driving electrical generators and other auxiliaries essential for safety and navigation, when they develop a power of 110 kW and over.

All other engines are to be designed and constructed according to sound marine practice.

Different certifications may be evaluated by the Society.

SECTION 3 PRESSURE VESSELS

1 General

1.1 General

1.1.1 Application

In general TASNEEF Rules for the Classification of Yachts (RES 31) Pt C, Ch 1, Sec 5 is applicable, as an alternative EN/ISO 10592 may be applied.

SECTION 4 GEARING

1 General

1.1 Application

1.1.1

All gears are to be designed and constructed according to sound marine practice and delivered with the relevant works' certificate.

Gearing approved prior to the application date and having a documented satisfactory service experience may be exempted from application of these Rules.

SECTION 5 MAIN PROPULSION SHAFTING

1 General

1.1 Application

1.1.1 This Section applies to shafts, couplings, clutches and other shafting components transmitting power for main propulsion.

1.2 Documentation to be submitted

1.2.1 The Manufacturer is to submit to the Society the drawing of the propeller shaft with relevant details and material specifications.

2 Design and construction

2.1 Materials

2.1.1 General

The use of other materials or steels having values of tensile strength exceeding the limits given in [2.1.2] will be considered by the Society in each case.

2.1.2 Shaft materials

In general, shafts are to be of forged steel having tensile strength, R_m, between 400 and 930 N/mm^2.

Where shafts may experience vibratory stresses close (i.e. higher than 80%) to the permissible stresses for transient operation, the materials are to have a specified minimum ultimate tensile strength (R_m) of 500 N/mm^2. Otherwise, materials having a specified minimum ultimate tensile strength (R_m) of 400 N/mm^2 may be used.

2.1.3 Couplings, flexible couplings, hydraulic couplings

Non-solid-forged couplings and stiff parts of elastic couplings subjected to torque are to be of forged or cast steel, or nodular cast iron.

Rotating parts of hydraulic couplings may be of grey cast iron, provided that the peripheral speed does not exceed 40m/s.

2.1.4 Coupling bolts

Coupling bolts are to be of forged, rolled or drawn steel.

2.1.5 Shaft liners

Liners are to be of metallic corrosion resistant material complying with the applicable requirements of Pt D and with the approved specification, if any; in the case of liners fabricated in welded lengths, the material is to be recognised as suitable for welding.

In general, they are to be manufactured from castings.

For small shafts, the use of liners manufactured from pipes instead of castings may be considered.

Where shafts are protected against contact with seawater not by metal liners but by other protective coatings, the coating procedure is to be approved by the Society.

2.1.6 Sterntubes

Sterntubes are to comply with the requirements of Pt B.

2.2 Shafts - Scantling

2.2.1 General

For the check of the scantling, the methods given in [2.2.2] and [2.2.3] . As an alternative, the direct stress calculation method may be applied.

Transitions of diameters are to be designed with either a smooth taper or a blending radius. For guidance, a blending radius equal to the change in diameter is recommended.

2.2.2 Propeller shafts

For propeller shafts in general a minimum specified tensile strength R_m to be introduced in the following formula not exceeding 600 N/mm^2 is to be taken for carbon, carbon manganese and alloy steel.

Where materials with greater specified or actual tensile strengths than the limitations given above are used, reduced shaft dimensions are not acceptable when derived from the formula in this item [2.2.3].

The minimum diameter of the propeller shaft is not to be less than the value d_P, in mm, given by the following formula:

$$d_P = 100 \cdot k_P \cdot \left[\frac{P}{n \cdot (1 - Q^4)} \cdot \frac{560}{R_m + 160} \right]^{1/3}$$

where:

k_p : Factor whose value, depending on the different constructional features of shafts, is given below.

The other symbols have the same meaning as in [2.2.2].

In cases of stainless steels and in other particular cases, at the discretion of the Society, the value of R_m to be introduced in the above formula will be specially considered. In general, the diameter of the part of the propeller shaft located forward of the forward sterntube seal may be gradually reduced to the diameter of the intermediate shaft.

The values of factor k_P to be introduced in the above formula are to be taken as 1.04.

2.2.3 Direct stress calculation method

Alternative calculation methods may be considered by the Society. Any alternative calculation method is to include all relevant loads on the complete dynamic shafting system under all permissible operating conditions. Consideration is to be given to the dimensions and arrangements of all shaft connections.

2.3 Propeller Shafts made of Corrosion resisting material

2.3.1 As an alternative to [2.2.2] the following paragraphs may be applied.

2.3.2 Corrosion-resistant shaft materials

For corrosion-resistant material, such as Aquamet 17, Aquamet 22, Nickel copper alloy - monel K 500, stainless steel type 316 and duplex steels, the following alternative formula can be used instead of that stated in item [2.2.2] and [2.2.3] to calculate the minimum diameter of the intermediate and propeller shafts:

$D = K_m [P / (n \times R_t)]^{1/3}$

where:

k_m : Material factor (see Tab 1);

D : Rule diameter of the intermediate and propeller shafts (mm);

P : Maximum service power (kW);

N : Shaft rational speed, in r.p.m., corresponding to P;

R_t : Yield strength in torsional shear (N/mm^2) (see Tab 1).

Shafts for which the scantling is determined according to the previous formula are to comply with the criteria listed in items a) to f), irrespective of the shaft material

a) If requested by the Society torsional and lateral shaft vibration analysis carried out according to Sec 8 is to be submitted to TASNEEF Rules for the Classification of Yachts, axial shaft vibration analysis may also be requested;

b) the span between two consecutive supports of the shaft is to be not more than the value given by the formula as indicated in [2.3.3];

c) the ratio between shaft diameter and propeller diameter is to be, in general, not more than 14:1;

d) the length of the cone shaft is to be verified in order to check that the sectional area of the key is not less than the value in mm^2 given by the formula given in [2.3.4];

Table 1 : Values of factor K_m and R_t

Material	Material factor (K_m)	Maximum value R_t (N/mm^2) to be introduced in the formula
Aquamet 17, Aquamet 22	650	500
Stainless steel type 316 (austenitic)	530	160
Nickel copper alloy - monel K 500	560	460
Duplex steels	500	500
Temet (duplex 2205)	620	450

2.3.3 Shaft bearing spacing

The maximum shaft bearing space is to be not more than the value given by the following formula:

$l = (0,7439 \times D)/N)^{1/2} \cdot (E/W_1)^{1/4}$

where:

l : maximum unsupported length (m);

D : shaft diameter (mm);

N : shaft speed (RPM);

E : modulus of elasticity of shaft material, in tension (MPa);

W_1 : shaft material specific weight (kg/dm^3).

The minimum required spacing for rigid bearings is to exceed 20 shaft diameters when possible, to facilitate the alignment.

2.3.4 Propeller shaft keys and keyways

The sectional area of the key subject to shear stress is to be not less than the value A, in mm^2, given by the following formula:

$$A = 155 \cdot \frac{d^3}{\sigma_t \cdot d_{PM}}$$

where:

d : is the Rule diameter calculated according to the formula in Sec 7, [2.2.2].

In any case R_m is to be assumed equal to 400 N/mm^2.

d_{pm} : is the diameter, in mm, of the cone at the middle length of the key

σ_t : is the specified minimum tensile strength (UTS) of the key material, in N/mm^2.

The effective area in crushing of key, shaft or boss is to be not less than:

$$A = 24 \cdot \frac{d^3}{\sigma_y \cdot d_{PM}}$$

where:

d : is the Rule diameter calculated according to the formula in Sec 7, [2.2.2].
In any case R_m is to be assumed equal to 400 N/mm^2.

d_{pm} : is the diameter, in mm, of the cone at the middle length of the key

σ_y : is the yield strength of the key, shaft boss material as appropriate, in N/mm^2.

2.4 Liners

2.4.1 General

TASNEEF Rules for the Classification of Yachts (RES 31) Pt C, Ch 1, Sec 7, [2.4] as far as practicable is to be applied.

2.4.2 Scantling

The thickness of metal liners fitted on propeller shafts or on intermediate shafts inside sterntubes is to be not less than the value t, in mm, given by the following formula:

$$t = \frac{d + 230}{32}$$

where:

d : Actual diameter of the shaft, in mm.

Between the sternbushes, the above thickness t may be reduced by 25%.

2.5 Stern tube bearings

2.5.1 General

TASNEEF Rules for the Classification of Yachts (RES 31) Pt C, Ch 1, Sec 7, [2.5] as far as practicable is to be applied.

2.6 Couplings

2.6.1 General

TASNEEF Rules for the Classification of Yachts (RES 31) Pt C, Ch 1, Sec 7, [2.6] as far as practicable is to be applied.

2.7 Control and monitoring

2.7.1 General

In addition to those given in this item [2.6], the requirements of Ch 3 apply.

3 Arrangement and installation

3.1 General

3.1.1 The installation is to be carried out according to the instructions of the component Manufacturer or approved documents, when required.

3.1.2 The installation of sterntubes and/or associated non-shrunk bearings is subject to approval of procedures and materials used.

3.1.3 The joints between liner parts are not to be located in way of supports and sealing glands.

Metal liners are to be shrunk on to the shafts by pre-heating or forced on by hydraulic pressure with adequate interference; dowels, screws or other means of securing the liners to the shafts are not acceptable.

3.2 Protection of propeller shaft against corrosion

3.2.1 The propeller shaft surface between the propeller and the sterntube, and in way of propeller nut, is to be suitably protected in order to prevent any entry of sea water, unless the shaft is made of austenitic stainless steel.

3.3 Shaft alignment

3.3.1 The Society may require the above calculation in the case of special arrangements.

The alignment of the propulsion machinery and shafting and the spacing and location of the bearings are to be such as to ensure that the loads are compatible with the material used and the limits prescribed by the Manufacturer.

SECTION 6 PROPELLERS

1 General

1.1 Application

1.1.1 Propulsion propellers

Propellers of any size and type intended for propulsion or not, are to be provided found suitable for the intended use and provided with work's certificate.

SECTION 7 PIPING SYSTEM

1 General

1.1 Application

1.1.1 This Section apply to piping systems for essential and not essential systems.

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 information listed in Tab 2 is also to be submitted.

Table 1 : Documents to be submitted

No.	I/A **(1)**	Document **(2)**
1	A	Drawing showing the arrangement of the sea chests and side valves
2	A	Diagram of the bilge
3	A	Diagram of ballast system (if any)
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
7	A	Diagram of fuel oil system
8	A	Drawings of the fuel oil tanks not forming part of the yacht‘s structure
9	A	Diagram of the hydraulic systems intended for essential services or located in machinery spaces
10	A	Diagram of the compressed air system
11	A	Diagram of the hydraulic and pneumatic remote control systems
12	A	Diagram of the exhaust gas system

(1) A = to be submitted for 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 : Information to be submitted

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

No.	I/A **(1)**	Document
6	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 approval; I = to be submitted for information.		

1.3 Definitions

1.3.1 General

TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [1.3] generally apply.

1.4 Symbols and units

1.4.1 TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [1.4] generally apply.

1.5 Class of piping systems

1.5.1 General

TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [1.4] generally apply.

2 General requirements for design and construction

2.1 General

2.1.1 General

TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [2] generally apply unless for what is differently reported in this Article.

2.1.2 Flexible hoses

As an alternative to TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [2.5] the following Table 3 may be applied regardless the gross tonnage ans the length of the vessel.

2.1.3 For what concerns the use of flexible hoses in Tab 3 are reported the minimum requirements applicable to piping for each system depending on the location.

The requirements of Sec 10 for non essential systems applies to Black water system as far as it is practicable and the system is to be in compliance at least to EN/ ISO 8099.

Table 3 : Use of flexible hoses

Requirements for each service and locations (1)		
System	Machinery space or other spaces with fire risk	Spaces without fire risk
Fuel oil system	Flexible hoses shall comply with the following requirements: • Hoses are to be in compliance with the ISO 7840 standard, type A1 or A2. • Hoses shall be used in agreement with the application limits required in the standard.	Flexible hoses shall comply with the following requirements: • as for machinery space; alternatively, hoses may be in compliance with the ISO 8461 standard, type B1 or B2. • Hoses shall be used in agreement with the application limits required in the standard.
Hydraulic oil system	Flexible hoses can be used, whatever the gross tonnage of the yacht, according to the following requirements. • Flexible hoses used for non essential services are not required to be fire resistant, but they are to be certified suitable for use by the manufacturer in compliance with national or international recognized standards. • Flexible hoses used for essential services (services whose failure can impair the safety of navigation); flexible hoses in compliance with [2.4] can be accepted: they shall be type approved according to [2.4.1] and fire resistant in compliance with ISO 15540/15541	Flexible hoses can be used, whatever the gross tonnage of the yacht, according to the following requirements. Flexible hoses are not required to be fire resistant, but they are to be certified suitable for use by the manufacturer in compliance with national or international recognized standards.
Fixed water fire extinguishing system	Flexible hoses shall comply with the following requirements: • They shall be made of material suitable to be used for the intended service and capable of maintaining their integrity at a maximum working temperature of not less than 100 °C. In addition, the requirements of Pt B, Ch 1, Sec 1, [5.3.2] are to be complied with • Reference is to be made to (2)	Flexible hoses shall comply with the following requirements: • They shall be made of material suitable to be used for the intended service and capable of maintaining their integrity at a maximum working temperature of not less than 100 °C. In addition, the requirements of Pt B, Ch 1, Sec 1, [5.3.2] are to be complied with • Reference is to be made to (2)
Bilge system	Flexible hoses shall comply with the following requirements: • They shall be made of material suitable to be used for the intended service and capable of maintaining their integrity at a maximum working temperature of not less than 100 °C. In addition, the requirements of Pt B, Ch 1, Sec 1, [5.3.2] are to be complied with • In any case, the flexible hose is to be certified suitable for use by the manufacturer • Reference is to be made to (2)	Flexible hoses shall comply with the following requirements: • flexible hoses built in PVC reinforced with embedded steel wire and additional fiber reinforcement or equivalent can be accepted. In any case, the flexible hose is to be certified suitable for use by the manufacturer • In addition, the requirements of Pt B, Ch 1, Sec 1, [5.3.2] are to be complied with • Reference is to be made to (2)

Requirements for each service and locations (1)		
System	Machinery space or other spaces with fire risk	Spaces without fire risk
Cooling system	Flexible hoses shall comply with the following requirements: • with the exclusion of the part of piping indicated in Pt B, Ch 1, Sec 1, [5.3.2], flexible hoses can be accepted in compliance with ISO 13363 or equivalent, and certified suitable for use by the manufacturer in compliance with national or international recognized standards. • Reference is to be made to (2)	Flexible hoses shall comply with the following requirements: • with the exclusion of the part of piping indicated in Pt B, Ch 1, Sec 1, [5.3.2], flexible hoses can be accepted in compliance with ISO 13363 or equivalent, and certified suitable for use by the manufacturer in compliance with national or international recognized standards. • Reference is to be made to (2)
Scupper pipe	Flexible hoses shall comply with the following requirements: • with the exclusion of the part of piping indicated in Pt B, Ch 1, Sec 1, [5.3.2], flexible hoses made of material suitable to be used for this service, and capable of maintaining their integrity at a maximum working temperature of not less than 100 °C can be accepted. • Reference is to be made to (2)	Flexible hoses shall comply with the following requirements: • Pt B, Ch 1, Sec 1, [5.3.2], flexible hoses built in PVC reinforced with embedded steel wire and additional fiber reinforcement or equivalent can be accepted. • In any case, the flexible hose is to be certified suitable for use by the manufacturer. • Reference is to be made to (2)
Exhaust system	The requirements of Pt B, Ch 1, Sec 1, [5.3.3] are to be complied with.	The requirements of Pt B, Ch 1, Sec 1, [5.3.3] are to be complied with.
Drinking water, black water and drainage of air-conditioning systems	Metallic hoses, flexible hoses. Flexible hoses shall comply with the following requirements • Any parts connected to the external discharge through the side of the hull shall comply with the requirements for the scuppers. • In any case, the flexible hose is to be certified suitable for use by the manufacturer. • Reference is to be made to (2)	Metallic hoses, flexible hoses. Flexible hoses shall comply with the following requirements • Any parts connected to the external discharge through the side of the hull shall comply with the requirements for the scuppers. • In any case, the flexible hose is to be certified suitable for use by the manufacturer. • Reference is to be made to (2)

(1) End connections different from the crimped type may be adopted only for Class III piping

(2) All systems provided with external discharge through the side of the hull are to be fitted with a metallic valve on the side of the hull. The above valve may be made of non metallic material provided that the sea discharge is positioned at a point corresponding to an angle more than 10° or more than the angle corresponding to the intersection of the deck with the side, whichever is the lesser

a) In any case, an adequate non-return valve is to be fitted where it is ascertained that under operating conditions the yacht may assume an angle of heel for which the ingress of water cannot be avoided.

b) Where joints are provided between the metallic branch and non-metallic pipe, they are to be adequate for the purpose. If joints with clamps are fitted, they are to be made of stainless steel. At least two clamps are to be fitted for each joint end. In general, the clamps are to be no less than 12 mm in width and are not to be dependent on spring tension to remain fastened.

3 Welding of steel piping

3.1 General

3.1.1 General

TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [3] generally apply.

4 Bending of pipes

4.1 General

4.1.1 General

TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [4] generally apply.

5 Arrangement and installation of piping systems

5.1 General

5.1.1 TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 1, Sec 10, [5] generally apply.

6 Bilge systems

6.1 Principle

6.1.1 Application

The bilge system is to be in compliance with the requirements contained in this Article. The compliance with EN/ISO 15083 may be evaluated as an alternative.

6.1.2 General

An efficient bilge pumping system shall be provided, capable of pumping from and draining any watertight compartment other than a space permanently appropriated for the carriage of fresh water, water ballast, 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 sea water piping damage.

6.1.3 Availability of the bilge system

The bilge system is to be able to work while the other essential installations of the yacht, are in service.

6.2 Design of bilge systems

6.2.1 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 [6.1.2] 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 yacht is not impaired.

6.2.2 Number and distribution of bilge suctions

a) Draining of watertight spaces is to be possible, when the is on an even keel and either is upright or has a list of up to 5°, by means of at least one suction each watertight space.

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.

c) In all cases, arrangements are to be made such as to allow a free and easy flow of water to bilge suctions.

6.2.3 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 other lines (except ballast).

6.3 Draining of machinery spaces/box

6.3.1 General

Where all the propulsion machinery and main auxiliaries are located in a single watertight space, the bilge suctions are to be distributed and arranged in accordance with the provisions of [6.2.2].

6.3.2 Branch bilge suction

The branch bilge suction is to be connected to the bilge main.

6.3.3 Emergency bilge suction

a) The emergency bilge suction is to be led directly from the drainage level of the machinery space to a main circulating (or cooling) pump and fitted with a non-return valve.

b) In yachts where, in the opinion of the Society, the main circulating (or cooling) pump is not suitable for this purpose, the emergency bilge suction is to be led from the largest available independent power driven pump to the drainage level of the machinery space. Such a pump is not to be a bilge pump. Its capacity when the emergency suction is operating is to be at least equal to the required capacity of each bilge pump as determined in [6.5.3].

c) The emergency bilge suction is to be located at the lowest possible level in the machinery spaces.

6.3.4 Number and distribution of suctions in propulsion machinery spaces

a) In propulsion machinery spaces, bilge suctions are to include:

- where the bottom of the space, bottom plating to the centreline by more than 5°, at least two centreline suctions, i.e. one branch bilge suction and one direct suction, or
- where the bottom of the space is horizontal or slopes down to the sides, at least two suctions, i.e. one branch bilge suction and one direct suction, on each side,
- and one emergency bilge suction.

b) If the tank top is of a particular design or shows discontinuity, additional suctions may be required.

c) Where the propulsion machinery space is located aft, suctions are normally to be provided on each side at the fore end and, except where not practicable due to the shape of the space, on each side at the aft end of the space.

d) In electrically propelled s, provision is to be made to prevent accumulation of water under electric generators and motors.

6.3.5 Number and distribution of suctions in auxiliary machinery spaces

In auxiliary compartments, bilge suctions are to include a branch suction.

6.4 Draining of spaces other than machinery spaces

6.4.1 General

Except where otherwise specified, bilge suctions are to be branch bilge suctions, i.e. suctions connected to a bilge main.

6.5 Bilge pumps

6.5.1 Number and arrangement of pumps

a) At least two power pumps connected to the main bilge system are to be provided, one of which may be driven by the propulsion machinery. Such pumps are to be fitted in two different compartment and they are to be fed by two different sources of power supplies. The location of pumps, their individual power supplies and controls, including those for bilge valves, is to be such that, in the event of any one compartment being flooded, another pump is available to control any leakage to adjacent compartments. Hand driven pumps are not acceptable. The second pump may be portable. Submergible pumps dedicated to each compartment may be evaluated as alternative to the main or the main or the emergency pump above mentioned.

b) Bilge pumps driven by the propulsion machinery are allowed.

c) Each pump may be replaced by a group of pumps connected to the bilge main, provided their total capacity meets the requirements specified in [6.5.4].

d) The two pumps are to have each its dedicated suction piping from each watertight compartment and its dedicated overboard discharge. The use of a common piping and/or a common overboard are acceptable provided that, where necessary, are fitted remote controlled valves so that it is possible to drain every watertight compartment with either pumps from outside the compartment where the main bilge pump and the manifold are located.

6.5.2 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.

6.5.3 Use of bilge pumps for other duties

Bilge pumps may be used for other duties, such as fire, general service, sanitary service or ballast provided that:

- such duties are of intermittent nature
- any failure of the piping systems connected to the bilge pumps does not render the bilge system inoperable
- pumps are immediately available for bilge duty when necessary.

6.5.4 Capacity of the pumps

a) Each power bilge pump is to be capable of pumping water through the required main bilge pipe at a speed of not less than 2 m/s.

b) The capacity of each pump or group of pumps is not to be less than:

$Q = 0{,}0058\ d^2$

where:

Q : Minimum capacity of each pump or group of pumps, in m^3/h

d : Internal diameter, in mm, of the bilge main as defined in [6.6.1].

c) If the capacity of one of the pumps or one of the groups of pumps is less than the Rule capacity, the deficiency may be compensated by an excess capacity of the other pump or group of pumps; as a rule, such deficiency is not permitted to exceed 30% of the Rule capacity.

d) Where an ejector is used in lieu of a driven pump, its suction capacity is not to be less than the required capacity of the pump it replaces.

6.5.5 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) Circulating or cooling water pumps connected to an emergency bilge suction need not be of the self-priming type.

c) Sanitary, ballast and general service pumps may be accepted as independent power bilge pumps if fitted with the necessary connections to the bilge pumping system.

6.5.6 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.

6.5.7 Electrical supply of submersible pump motors

a) Where submersible bilge pumps are provided, arrangements are to be made to start their motors from a convenient position above the bulkhead deck.

b) Where an additional local-starting device is provided at the motor of a permanently installed submersible bilge pump, the circuit is to be arranged to provide for the disconnection of all control wires there from at a position adjacent to the starter installed on the deck.

6.6 Size of bilge pipes

6.6.1 Bilge main line

a) The diameter of the bilge main is to be calculated according to the following formula:

$$d = 25 + 0,085L$$

where:

d : The internal diameter of the bilge main, in mm

L : Rule length, in m.

b) Where the bilge pumps are designed to pump from the machinery space only, the internal diameter d, in mm, of the bilge main may be less than that required in (a) but not less than that calculated with the following formula:

$$d = 25 + 0,085L_0$$

where:

L_0 : Length of the engine room, in m

In any case, the internal section of the bilge main is not to be less than twice that of the bilge suction pipes determined from [6.6.3].

c) In no case is the actual internal diameter to be:
   - more than 5 mm smaller than that obtained from the formula given in a) or b), or
   - less than 40 mm.

Relaxations may be considered by the Society.

6.6.2 Distribution box branch pipes

The cross-section of any branch pipe connecting the bilge main to a bilge distribution box is not to be less than the sum of the cross-sections required for the two largest branch suctions connected to this box. However, this cross-section need not exceed that of the bilge main.

6.6.3 Branch bilge suction pipes

The internal diameter, in mm, of pipes situated between distribution boxes and suctions in holds and machinery spaces is not to be less than the diameter given by the following formula:

$$d_1 = 0,085L_1 + 25$$

where:

L_1 : Length of the compartment, in m.

d_1 is not to be less than 25 mm and need not exceed 100 mm. Relaxations may be considered by the Society.

6.6.4 Emergency suctions in machinery spaces

a) The diameter of emergency bilge suction pipes is to be the same as the diameter of the pump inlet :

b) Where the emergency suction is connected to a pump other than a main circulating or cooling pump, the suction is to be the same diameter as the main inlet of the pump.

6.7 Bilge accessories

6.7.1 Drain valves on watertight bulkheads

a) The fitting of drain valves or similar devices is not allowed on the collision bulkhead.

b) On other watertight bulkheads, the fitting of drain valves or similar devices is allowed unless practical alternative draining means exist. Such valves are to be easily accessible at all times and operable from above the freeboard deck. Means indicating whether the valves are open or closed are to be provided.

6.7.2 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. For this purpose, non-return devices are to be fitted:
   - on the pipe connections to bilge distribution boxes or to the alternative valves, if any
   - on direct and emergency suctions in machinery spaces
   - on the suctions of pumps which also have connections from the sea or from compartments normally intended to contain liquid
   - on flexible bilge hose connections
   - on the suctions of water bilge ejectors
   - at the open end of bilge pipes passing through deep tanks
   - in compliance with the provisions for the prevention of progressive flooding, if applicable.

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.

6.7.3 Bilge Alarm

A bilge level alarm is to be fitted. Such an alarm is to provide an audible and visual warning in the Master's cabin and in the wheel-house. The audible and visual alarm may be accepted elsewhere if it is considered that such a location may by more appropriate

7 Ballast systems

7.1 General

7.1.1 Application

If a ballast system is fitted is to be in compliance with general principles of TASNEEF Rules for the Classification of Yachts (RES 31) Pt C, Ch 1, Sec 10, [7].

8 Scuppers and sanitary discharges

8.1 Application

8.1.1 This Article applies to:

- scuppers and sanitary discharge systems, and
- discharges from sewage tanks.

8.2 Principle

8.2.1

a) Scuppers, sufficient in number and suitable in size, are to be provided to permit the drainage of water likely to accumulate in the spaces which are not located in the 's bottom. The Society may permit the means of drainage to be dispensed with in any particular compartment if it is satisfied that, by reason of size or internal subdivision of such space, the safety of the yacht is not impaired.

b) The number of scuppers and sanitary discharge openings in the shell plating is to be reduced to a minimum either by making each discharge serve as many as possible of the sanitary and other pipes, or in any other satisfactory manner.

8.3 Drainage from spaces below the deck or within enclosed superstructures and deckhouses on the deck

8.3.1 Normal arrangement

Scuppers and sanitary discharges from spaces below the deck or from within superstructures and deckhouses on the deck fitted with weathertight doors are to be led to:

a) a suitable space, or spaces, of appropriate capacity, having a high water level alarm and provided with suitable pumping arrangements for discharge overboard. In addition, it is to be ensured that:

   1) the number, size and arrangement of the scuppers are such as to prevent unreasonable accumulation of free water,

   2) the pumping arrangements take account of the requirements for any fixed pressure water-spraying fire-extinguishing system

b) suitable sanitary tanks in the case of sanitary discharges.

8.3.2 Material

The scuppers and sanitary discharges are to be made of steel or any other material approved for the application considered. Minimum thickness is reported in [9.4].

8.4 Arrangement of scuppers and discharge

8.4.1 General

Scupper and discharge pipes originating at any level and penetrating the shell are to be provided with a metallic non-return valve at the shell. The above valve may be made of non metallic material provided that the sea discharge is positioned at a point corresponding to an angle more than 10° or more than the angle corresponding to the intersection of the deck with the side, whichever is the less.

8.5 Valves and pipes

8.5.1 Materials

All shell fittings, pipes and valves required to be metallic may be made of steel, copper, stainless steel or alluminium.Valves of ordinary cast iron or similar material are not acceptable. All the pipes and valves not required to be metallic may be made of plastic.

8.5.2 Thickness of pipes

The thickness of scupper and discharge pipes is to be substantial from the shell to the side valve.

8.5.3 Operation of the valves

Where plastic pipes are used for sanitary discharges and scuppers, below the summer waterline the valve at the shell is to be operated locally and to be easy accessible.

9 Air, sounding and overflow pipes

9.1 Air pipes

9.1.1 Principle

Air pipes are to be fitted to all tanks 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. Their open ends are to be so arranged as to prevent the free entry of sea water in the compartments.

9.1.2 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 yacht 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 will be given special consideration by the Society.

d) Where only one air pipe is provided, it is not to be used as a filling pipe.

9.1.3 Location of open ends of air pipes

a) Air pipes of tanks and other compartments which can come into contact with the sea or be flooded in the event of hull damage are to be led as close as possible to the deck.

b) Air pipes of tanks intended to be pumped up are to be led to the open as close as possible to the deck.

c) Air pipes of tanks other than oil tanks may discharge through the side of the superstructure contributing to buoyancy.

d) The location of air pipes for flammable oil tanks is also to comply with [9.1.5].

9.1.4 Fitting of closing appliances

a) Satisfactory appliances which are permanently attached are to be provided for closing the openings of air pipes in order to prevent the free entry of water into the spaces concerned.

b) Automatic closing appliances are to be recognised by the Society

9.1.5 Special arrangements for air pipes of flammable oil tanks

a) Air and overflow pipes and relief valves of fuel oil and thermal oil systems are to discharge to a position on the open deck where there is no risk of fire or explosion from the emergence of oils and vapour.

The open ends are to be fitted with flame screens made of corrosion resistant material and readily removable for cleaning and replacement. The clear area of such screens is not to be less than the cross-sectional area of the pipe.

b) Air pipes of lubricating or hydraulic oil storage tanks not subject to flooding in the event of hull damage may be led to machinery spaces, provided that in the case of overflowing the oil cannot come into contact with electrical equipment, hot surfaces or other sources of ignition.

c) The location and arrangement of vent pipes for fuel oil service, settling and lubrication oil tanks are to be such that in the event of a broken vent pipe there is no risk of ingress of seawater or rainwater.

d) Air pipes of fuel oil service, settling and lubrication oil tanks likely to be damaged by impact forces are to be adequately reinforced.

9.1.6 Construction of air pipes

a) Where air pipes to ballast and other tanks extend above the deck or superstructure deck, the exposed parts of the pipes are to be of substantial construction.

b) In each compartment likely to be pumped up, and where no overflow pipe is provided, the total cross-sectional area of air pipes is not to be less than 1,25 times the cross-sectional area of the corresponding filling pipes.

c) The internal diameter of air pipes is not to be less than 50 mm, except for tanks of less than 2 m^3.

9.2 Sounding pipes

9.2.1 General

Where sounding devices are fitted to tanks intended to contain liquids as well as to all compartments which are not readily accessible at all times they have to be built in accordance with the relevant provisions of TASNEEF Rules for the Classification of Yachts (RES 31).

9.3 Overflow pipes

9.3.1 General

Where overflow pipes are fitted to tanks intended to contain liquids as well as to all compartments which are not readily accessible at all times they have to be built in accordance with the relevant provisions of TASNEEF Rules for the Classification of Yachts (RES 31).

9.4 Constructional requirements applying to sounding, air and overflow pipes

9.4.1 Materials

Sounding, air and overflow pipes are to be made of steel or any other material approved for the application considered.

9.4.2 Minimum thickness of steel pipes

The minimum thickness of sounding, air and overflow steel pipes is given in Tab 4. For materials other than steel the minimum thickness may be reduced considering the relevant mechanical characteristic of the material.

Table 4 : Minimum wall thickness of sounding, air and overflow pipes

External diameter (mm)	Minimum wall thickness (mm) **(1)**
up to 168,3	4,5
177,8	5,0
193,7	5,4
219,1	5,9
above 244,5	6,3
(1) Applies only to structural tanks.	

10 Cooling systems

10.1 Principle

10.1.1 General

Sea water and fresh water cooling systems are to be so arranged as to maintain the temperature of the cooled media for propulsion machinery and essential equipment within the manufacturers' recommended limits during all operations, including starting and manoeuvring, under the inclination angles and the ambient conditions specified in Sec 1.

11 Fuel oil systems

11.1 Application

11.1.1 Scope

This Article applies to all fuel oil systems supplying any kind of installation.

11.2 Principle

11.2.1 General

a) Fuel oil systems are to be so designed as to ensure the proper characteristics (purity, viscosity, pressure) of the fuel oil supply to engines.

b) Fuel oil systems are to be so designed as to prevent:
   - overflow or spillage of fuel oil from tanks, pipes, fittings, etc.
   - fuel oil from coming into contact with sources of ignition
   - overheating and seizure of fuel oil.

11.2.2 Availability of fuel systems

a) Fuel oil systems are to be so designed that, in the event that any one essential auxiliary of such systems becomes inoperative, the fuel oil supply to engines can be maintained (see also [11.2.1] a)). Partial reduction of the propulsion capability may be accepted, however, when it is demonstrated that the safe operation of the yacht is not impaired.

b) Fuel oil tanks are to be so arranged that, in the event of damage to any one tank, complete loss of the fuel supply to essential services does not occur.

11.3 General

11.3.1 Arrangement of fuel oil systems

In yacht in which fuel oil is used, the arrangements for the storage, distribution and utilisation of the fuel oil are to be such as to ensure the safety of the yacht and persons on board.

11.3.2 Provision to prevent overpressure

Provisions are to be made to prevent overpressure in any oil tank or in any part of the fuel oil system. Any relief valve is to discharge to a safe position.

11.3.3 Ventilation

The ventilation of machinery spaces is to be sufficient under all normal conditions to prevent accumulation of oil vapour.

11.3.4 Access

Spaces where fuel oil is stored or handled are to be readily accessible.

11.4 Design of fuel oil filling and transfer systems

11.4.1 General

A system of pumps and piping for filling and transferring fuel oil is to be provided.

11.4.2 Filling systems

Filling pipes of fuel oil tanks are to terminate on open deck or in filling stations isolated from other spaces and efficiently ventilated.

11.5 Arrangement of fuel oil tanks

11.5.1 Location of fuel oil tanks

a) No fuel oil tank is to be situated where spillage or leakage there from can constitute a hazard by falling on heated surfaces.

b) As far as practicable, fuel oil tanks are to be part of the yacht's structure and are to be located outside machinery spaces of category A.

c) The location of fuel oil tanks is to be in compliance with the requirements of Pt B, Ch 2, particularly as regards the installation of cofferdams, the separation between fuel oil tanks and fresh water tanks.

11.5.2 Use of free-standing fuel oil tanks

a) In general the use of free-standing fuel oil tanks is permitted in category A machinery spaces.Portable fuel tank have to be in accordance with EN/ISO 13591,

b) Fixed fuel tanks, that are not part of the yacht's structure have to be in accordance with EN/ISO 10088.

11.6 Design of supply systems

11.6.1 Fuel Valve

The supply system is to foreseen a remote control valve located as close as possible to the fuel tank so that the fuel supply may be cut in case of fire or damage.

11.6.2 Engine shut off

It is to be possible to shut off the internal combustion engines from outside the machinery space. If an electromeccanic remote control is used it is to close the valve in case of loss of electrical power.

11.7 Construction of fuel oil piping systems

11.7.1 Materials

Fuel oil pipes and their valves are to be of steel or other approved material, except that the use of flexible pipes may be accepted provided they comply with the relevant requirement.

12 Hydraulic systems

12.1 Application

12.1.1 Hydraulic installations intended for essential services

Unless otherwise specified, this Article applies to all hydraulic power installations intended for essential services, including:

- actuating systems of steering gear
- actuating systems of sailing appliances and foils
- remote control of valves.

12.1.2 Hydraulic installations located in spaces containing sources of ignition

Hydraulic power installations not serving essential services but located in spaces where sources of ignition are present are to comply with the provisions of [12.3.2], [12.3.3], [12.4.3] and [12.4.4].

12.1.3 Low pressure or low power hydraulic installations

Hydraulic power installations with a design pressure of less than 2,5 MPa and hydraulic power packs of less than 5 kW will be given special consideration by the Society.

12.1.4 Very high pressure hydraulic installations

Hydraulic power installations with a design pressure exceeding 35 MPa will be given special consideration by the Society.

12.2 Principle

12.2.1 General

Hydraulic systems are to be so designed as to:

- avoid any overload of the system
- maintain the actuated equipment in the requested position (or the driven equipment at the requested speed)
- avoid overheating of the hydraulic oil
- prevent hydraulic oil from coming into contact with sources of ignition.

12.2.2 Availability

a) Hydraulic systems are to be so designed that, in the event that any one essential component becomes inoperative, the hydraulic power supply to essential services can be maintained. Partial reduction of the propulsion capability may be accepted, however, when it is demonstrated that the safe operation of the yacht is not impaired. Such reduction of capability is not acceptable for steering gear.

b) When a hydraulic power system is simultaneously serving one essential system and other systems, it is to be ensured that:
   - any operation of such other systems, or
   - any failure in the whole installation external to the essential system

   does not affect the operation of the essential system.

12.3 General

12.3.1 Definitions

a) A power unit is the assembly formed by the hydraulic pump and its driving motor.

b) An actuator is a component which directly converts hydraulic pressure into mechanical action.

12.3.2 Limitations of use of hydraulic oils

a) Oils used for hydraulic power installations are to have a flashpoint not lower than 150°C and be suitable for the entire service temperature range.

b) The hydraulic oil is to be replaced in accordance with the specification of the installation manufacturer.

12.3.3 Location of hydraulic power units

a) Whenever practicable, hydraulic power units are to be located outside main engine rooms.

b) Where this requirement is not complied with, shields or similar devices are to be provided around the units in order to avoid an accidental oil spray or mist on heated surfaces which may ignite oil.

12.4 Design of hydraulic systems

12.4.1 Power units

a) Hydraulic power installations are to include at least two power units so designed that the services supplied by the hydraulic power installation can operate simultaneously with one power unit out of service. A reduction of the performance not affecting the safety of the yacht may be accepted.

b) Low power hydraulic installations not supplying essential services may be fitted with a single power unit, provided that alternative means, such as a hand pump, are available on board.

c) For steering gear see Sec.11.

12.4.2 Filtering equipment

a) A device is to be fitted which efficiently filters the hydraulic oil in the circuit.

b) Where filters are fitted on the discharge side of hydraulic pumps, a relief valve leading back to the suction or to any other convenient place is to be provided on the discharge of the pumps.

12.4.3 Provision for cooling

Where necessary, appropriate cooling devices are to be provided.

12.4.4 Provision against overpressure

a) Safety valves of sufficient capacity are to be provided at the high pressure side of the installation.

b) Safety valves are to discharge to the low pressure side of the installation or to the service tank.

12.4.5 Provision for venting

Cocks are to be provided in suitable positions to vent the air from the circuit.

12.5 Design of hydraulic tanks and other components

12.5.1 Hydraulic oil service tanks

Service tanks intended for hydraulic power installations supplying essential services are to be provided with at least:

- a level gauge
- a temperature indicator
- a level switch. The level switch may be omitted in the case of hydraulic systems capable of being operated only in local position.

12.5.2 Hydraulic oil storage tanks

a) Hydraulic power installations supplying essential services are to include a storage tank of sufficient capacity to refill the whole installation should the need arise case of necessity.

b) For hydraulic power installations of less than 5 kW, the storage means may consist of sealed drums or tins stored in satisfactory conditions.

12.5.3 Hydraulic accumulators

The hydraulic side of the accumulators which can be isolated is to be provided with a relief valve or another device offering equivalent protection in case of overpressure.

12.6 Construction of hydraulic oil piping systems

12.6.1 Materials

a) Pipes are to be made of seamless steel. The use of welded steel pipes will be given special consideration by the Society.

b) The use of flexible hoses may be accepted if they comply with the relevant requirements.

13 Compressed air systems

13.1 Application

13.1.1 This Article applies to compressed air systems intended for essential services.

13.2 Principle

13.2.1 General

a) Compressed air systems are to be so designed that the compressed air delivered to the consumers:
   - is free from oil and water,
   - does not have an excessive temperature.

b) Compressed air systems are to be so designed as to prevent overpressure in any part of the systems.

13.2.2 Availability

a) Compressed air systems are to be so designed that, in the event of failure of one air compressor or one air receiver intended for starting, control purposes or other essential services, the air supply to such services can be maintained.

b) The compressed air system for starting main engines and auxiliary engines for essential services is to be so arranged that it is possible to ensure the initial charge of air receiver(s) without the aid of a power source outside the yacht.

13.3 Design of control and monitoring air systems

13.3.1 Air supply

a) The control and monitoring air supply to essential services is to be available from two sources of a sufficient capacity to allow normal operation with one source out of service.

b) At least one air vessel fitted with a non-return valve is to be provided for control and monitoring purposes.

c) Pressure reduction units used in control and monitoring air systems intended for essential services are to be duplicated, unless an alternative air supply is provided.

d) Failure of the control air supply is not to cause any sudden change of the controlled equipment which may be detrimental to the safety of the yacht.

13.3.2 Pressure control

Arrangements are to be made to maintain the air pressure at a suitable value in order to ensure satisfactory operation of the installation.

13.3.3 Air treatment

Arrangements are to be made to ensure cooling, filtering and drying of the air prior to its introduction in the monitoring and control circuits.

13.4 Materials

13.4.1 Pipes and valve bodies in control and monitoring air systems and in other air systems intended for non-essential services may be made of plastic in accordance with the provisions of App 1.

13.5 Arrangement of compressed air piping systems

13.5.1 Prevention of overpressure

Means are to be provided to prevent overpressure in any part of compressed air systems. Suitable pressure relief arrangements are to be provided for all systems.

13.5.2 Air supply to compressors

a) Provisions are to be made to reduce to a minimum the entry of oil into air pressure systems.

b) Air compressors are to be located in spaces provided with sufficient ventilation.

13.5.3 Air treatment and draining

a) Provisions are be made to drain air pressure systems.

b) Efficient oil and water separators, or filters, are to be provided on the discharge of compressors, and drains are to be installed on compressed air pipes wherever deemed necessary.

14 Exhaust gas systems

14.1 General

14.1.1 Application

This Article applies to exhaust gas pipes from engines.

14.1.2 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.

14.2 Design of exhaust systems

14.2.1 General

Exhaust systems are to be so arranged as to minimise the intake of exhaust gases into manned spaces, air conditioning systems and engine intakes. The exhaust piping is to be fitted in a manner such as to ensure an adequate air gap from the adjacent hull structure and other fittings; such air gap is to be, in general, not less than 200 mm.

14.2.2 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 where a temperature rise may be dangerous.

b) The insulation of exhaust systems is to comply with the provisions of Sec 1.

14.2.3 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 manufacturers.

14.2.4 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 .

b) Where exhaust pipes are water cooled, they are to be so arranged as to be self-draining overboard.

14.3 Materials

14.3.1 General

Materials of exhaust gas pipes and fittings are to be resistant to exhaust gases and suitable for the maximum temperature expected.

14.3.2 Use of plastics

The use of non-metallic materials may be accepted in water cooled systems in accordance with the provisions of App 1.

14.4 Arrangement of exhaust piping systems

14.4.1 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.

14.4.2 Provision for draining

a) Drains are to be provided where necessary in exhaust systems 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.

14.4.3 Flexible hoses

The use of flexible hoses in water cooled exhaust systems will be given special consideration by the Society.

14.4.4 Silencers

Engine silencers are to be so arranged as to provide easy access for cleaning and overhaul.

SECTION 8 STEERING

1 General

1.1 Application

1.1.1 General

As a general rule, TASNEEF Rules for the Classification of yachts (RES 31), Pt C, Ch 1, Sec 11 may be applied, as an alternative also EN/ ISO 10592 and EN/ ISO 25197 may be acceptable.

1.1.2

In case of application of TASNEEF Rules for the Classification of yachts (RES 31), Pt C, Ch 1, Sec 11 special considerations may be done with reference to the performances of the auxiliary steering system.

SECTION 9 THRUSTER

1 General

1.1 Application

1.1.1 Thrusters of any size and type intended for propulsion or not, are to be provided found suitable for the intended use and provided with work's certificate.

SECTION 10 TESTS ON BOARD

1 General

1.1 Application

1.1.1 Tests on board may be required by the Society.

APPENDIX 1 PLASTIC PIPES

1 General

1.1 Application

1.1.1 These requirements are applicable to all piping systems with parts made of rigid plastic or with parts made predominantly of other material than metal.

1.1.2 Piping systems made of thermoplastic materials, such as polyethylene(PE), polypropylene(PP), and polybutylene (PB), and intended for non-essential services are to meet the requirements of recognised standards as well as [2.1.2], [2.3.4], [2.4.2], [3] and [4].

1.1.3 The use of mechanical joints approved for the use in metallic piping systems only are not permitted.

1.2 Use of plastic pipes

1.2.1 Plastic may be used in piping systems in accordance with the provisions of Sec 10, provided the following requirements are complied with.

1.2.2 Plastic pipes are to be type approved by the Society or be certified in accordance to a suitable national or international standard..

1.3 Definitions

1.3.1 Plastic

Plastic includes both thermoplastic and thermosetting plastic materials with or without reinforcement, such as PVC and FRP (reinforced plastic pipes).

1.3.2 Piping systems

Piping systems mean those made of plastic and include the pipes, fittings, joints, and any internal or external liners, coverings and coatings required to comply with the performance criteria.

1.3.3 Joints

Joints include all pipe assembling devices or methods, such as adhesive bonding, laminating, welding, etc.

1.3.4 Fittings

Fittings include bends, elbows, fabricated branch pieces, etc made of plastic materials.

1.3.5 Nominal pressure

Nominal pressure is the maximum permissible working pressure.

1.3.6 Design pressure

Design pressure is the maximum working pressure which is expected under operating conditions or the highest set pressure of any safety valve or pressure relief device on the system, if fitted.

1.3.7 Fire endurance

Fire endurance is the capability of the piping system to perform its intended function, i.e. maintain its strength and integrity, for some predicted period of time while exposed to fire.

1.3.8 Essential to the safety of yacht

Essential to the safety of ship means all piping systems that in event of failure will pose a threat to personnel and the yacht.

2 Design of plastic piping systems

2.1 General

2.1.1 Specification

The specification of the plastic piping is to be submitted. It is to comply with a recognised national or international standard approved by the Society. In addition, the requirements stated below are to be complied with.

2.1.2 Marking

Plastic pipes and fittings are to be permanently marked with identification, including:

- pressure ratings
- the design standards that the pipe or fitting is manufactured in accordance with
- the material of which the pipe or fitting is made.

2.2 Strength

2.2.1 General

a) The piping is to have sufficient strength to take account of the most severe concomitant conditions of pressure, temperature, the weight of the piping itself and any static and dynamic loads imposed by the design or environment.

b) The maximum permissible working pressure is to be specified with due regard for the maximum possible working temperature in accordance with the Manufacturer's recommendations.

2.2.2 Permissible pressure

Piping systems are to be designed for a nominal pressure determined from the following conditions:

a) Internal pressure

The nominal internal pressure is not to exceed the smaller of:

- $P_{sth}/4$
- $P_{lth}/2,5$

where:

P_{sth} : Short-term hydrostatic test failure pressure, in MPa

P_{lth} : Long-term hydrostatic test failure pressure (>100 000 hours), in MPa.

b) External pressure (to be considered for any installation subject to vacuum conditions inside the pipe or a head of liquid acting on the outside of the pipe)

The nominal external pressure is not to exceed $P_{col}/3$, where:

P_{col} : Collapse pressure

Note 1: The external pressure is the sum of the vacuum inside the pipe and the static pressure head outside the pipe.

The collapse pressure is not to be less than 0,3 MPa.

c) c) Notwithstanding the requirements of a) or b) as applicable, the pipe or pipe layer minimum wall thickness is to follow recognized standards. In the absence of standards for pipes not subject to external pressure, the requirements of b) are to be met.

2.2.3 Permissible temperature

a) In general, plastic pipes are not to be used for media with a temperature above 60°C or below 0°C, unless satisfactory justification is provided to the Society.

b) The permissible working temperature range depends on the working pressure and is to be in accordance with the Manufacturer's recommendations.

c) The maximum permissible working temperature is to be at least 20°C lower than the minimum heat distortion temperature of the pipe material, determined according to ISO 75 method A or equivalent e.g. ASTMD648-18.

d) The minimum heat distortion temperature is not to be less than 80°C.

2.2.4 Axial strength

a) The sum of the longitudinal stresses due to pressure, weight and other loads is not to exceed the allowable stress in the longitudinal direction.

b) In the case of fibre reinforced plastic pipes, the sum of the longitudinal stresses is not to exceed half of the nominal circumferential stress derived from the nominal internal pressure condition (see [2.2.2]).

2.2.5 Impact resistance

Plastic pipes and joints are to have a minimum resistance to impact in accordance with a recognised national or international standard.

2.3 Pipe and fitting connections

2.3.1 General

a) The strength of connections is not to be less than that of the piping system in which they are installed.

b) Pipes and fittings may be assembled using adhesive-bonded, welded, flanged or other joints.

c) When used for joint assembly, adhesives are to be suitable for providing a permanent seal between the pipes and fittings throughout the temperature and pressure range of the intended application.

d) Tightening of joints, where required, is to be performed in accordance with the Manufacturer's instructions.

e) Procedures adopted for pipe and fitting connections are to be submitted to the Society for approval, prior to commencing the work.

2.3.2 Bonding of pipes and fittings

a) The procedure for making bonds is to be submitted to the Society for qualification. It is to include the following:
- materials used
- tools and fixtures
- joint preparation requirements
- cure temperature
- dimensional requirements and tolerances
- acceptance criteria for the test of the completed assembly.

b) When a change in the bonding procedure may affect the physical and mechanical properties of the joints, the procedure is to be requalified.

3 Arrangement and installation of plastic pipes

3.1 General

3.1.1 Plastic pipes and fittings are to be installed in accordance with the Manufacturer's guidelines.

3.2 Supporting of the pipes

3.2.1

a) Selection and spacing of pipe supports in board systems are to be determined as a function of allowable stresses and maximum deflection criteria.

b) The selection and spacing of pipe supports are to take into account the following data:
- pipe dimensions
- mechanical and physical properties of the pipe material
- mass of pipe and contained fluid
- external pressure
- operating temperature
- thermal expansion effects
- load due to external forces
- thrust forces
- water hammer
- vibrations
- maximum accelerations to which the system may be subjected.

Combinations of loads are also to be considered.

c) Support spacing is not to be greater than the pipe Manufacturer's recommended spacing.

3.2.2 Each support is to evenly distribute the load of the pipe and its content over the full width of the support. Measures are to be taken to minimise wear of the pipes where they are in contact with the supports.

3.2.3 Heavy components in the piping system such as valves and expansion joints are to be independently supported.

3.3 Provision for expansion

3.3.1 Suitable provision is to be made in each pipeline to allow for relative movement between pipes made of plastic and the steel structure, having due regard to:

- the high difference in the coefficients of thermal expansion
- deformations of the ’s structure.

3.3.2 Calculations of the thermal expansions are to take into account the system working temperature and the temperature at which the assembly is performed.

3.4 External loads

3.4.1 When installing the piping, allowance is to be made for temporary point loads, where applicable. Such allowance is to include at least the force exerted by a load (person) of 100 kg at mid-span on any pipe of more than 100 mm nominal outside diameter.

3.4.2 Pipes are to be protected from mechanical damage where necessary.

3.4.3 As well as providing adequate robustness for all piping, including open-ended piping, the minimum wall thickness complying with [2.2.2] a) may be increased at the request of the Society taking into account the conditions encountered during service on board vessels.

3.5 Earthing

3.5.1 Where, in pursuance of [2.3.4], pipes are required to be electrically conductive, the resistance to earth from any point in the piping system is not to exceed 1×10^6 ohm.

3.5.2 Where provided, earthing wires are to be accessible for inspection.

Chapter 2
ELECTRICAL INSTALLATIONS

SECTION 1 GENERAL

1 Application

1.1 General

1.1.1 The requirements of this Chapter apply to electrical installations on racing yachts. In particular, they apply to the components of electrical installations for:

- primary essential services
- secondary essential services
- services for habitability and air conditioning.

The other parts of the installation are to be so designed as not to introduce any risks or malfunctions to the above services.

As an alternative to this Section, EN/ISO 13297 may be applied.

For electrical propulsion see the dedicated Section.

1.2 References to other regulations and standards

1.2.1 The Society may refer to other regulations and standards when deemed necessary. These include the IEC publications, notably the IEC 60092 series and EN/ ISO standards.

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 certification.

2 Documentation to be submitted

2.1

2.1.1 The following documents are to be submitted:

- Single line diagram of main and emergency electric distribution systems,
- Single line diagram and detailed wiring diagram of the main and emergency switchboard,
- Single line diagram and detailed wiring diagram of the main distribution boards, and motor control centers,
- A functional diagram of the distribution board specially reserved for the navigation lights,
- Schedule for recording of the type, location and maintenance cycle of batteries used for essential and emergency services,

For electrical propulsion installations:

- Single line diagram of power distribution
- Single line diagram of control system and its power supply diagram,
- Wiring diagrams of power and control switchboards,
- Alarm and monitoring system technical specification, including list of alarms and monitoring points and its power supply diagram,
- Safety system including the list of monitored parameters and its power supply diagram

For BATTERY POWERED racing yachts see the relevant Appendix.

- A Single line diagram and a wiring diagram of the electric power circuits for steering gear

- General arrangement plan of the yacht showing location of main items of the electrical system
- Electrical diagram of the automatic fire detection and alarm systems and manually operated call points.
- Electrical diagram of the fixed gas fire-extinguishing systems.
- Diagram of the remote stop system (ventilation, fuel pumps, etc.).

The list of documents requested is to be intended as guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the system, equipment or components.

2.1.2
In addition to the documentation listed above, a FMEA, carried out according to the TASNEEF "Guide for Failure mode and Effect Analysis" or other equivalent methods, and a Test Program, identifying the tests to be carried out in order to verify the assumptions and conclusions of the FMEA, may be requested on a case-by-case basis, depending on the influence on the overall safety, of specific systems.

2.1.3
When an alteration or addition to an existing installation is proposed, updated plans are to be submitted for approval. As a minimum a technical specification, schematic diagrams and a proposed list of tests to be carried out onboard at the presence of the TASNEEF Surveyor are to be included.

2.1.4
Where computer based systems are implemented and used to control the electrical installation, or to provide safety functions in accordance with the requirements of this Chapter (e.g. electric propulsion, steering gear, emergency safety systems etc.), the arrangements are to satisfy the applicable requirements of Chapter 3.

3 Definitions

3.1 General

3.1.1 “Definitions” in TASNEEF Rules for the Classification of Yachts (RES 31) Pt C, Ch 2, Sec 1 apply.

SECTION 2 GENERAL DESIGN REQUIREMENTS

1 Environmental conditions

1.1 General

1.1.1 The electrical components of installations are to be designed and constructed to operate satisfactorily under the environmental conditions on board.

1.2 Inclinations

1.2.1 The electrical and electronic installations have to be suitable to operate safely and continuously up to the maximum angle of operation of the racing yacht.

1.3 Vibrations

1.3.1 The electrical and electronic installations have to be suitable to operate safely and continuously up to the maximum vibrations expected during operation of the racing yacht.

2 Quality of power supply

2.1 Voltage and frequency variation

2.1.1
All electrical appliances supplied from the main or emergency systems, if any , are to be so designed and manufactured that they are capable of operating satisfactorily under the normally occurring variations in voltage and frequency. All DC equipment shall be capable of function within a voltage range of 75 % to 133 % of nominal voltage at the battery terminals. The basic limits and associated requirements are that AC systems shall be designed to operate within the following limits: a) frequency: +/- 5%, b) voltage: + 6% / - 10%.

3 Materials

3.1 General

3.1.1 In general, and unless it is adequately protected, all electrical equipment is to be constructed of durable, flame-retardant, moisture-resistant materials which are not subject to deterioration in the atmosphere and at the temperatures to which they are likely to be exposed. Particular consideration is to be given to sea air and oil vapour contamination.

3.2 Insulating materials for windings

3.2.1 Insulated windings are to be resistant to moisture, sea air and oil vapour unless special precautions are taken to protect insulants against such agents.

3.3 Insulating materials for cables

3.3.1 See dedicated Section “Cables”.

4 Construction

4.1 General

4.1.1 All electrical apparatus is to be so constructed as not to cause injury when handled or touched in the normal manner.

4.1.2 The design of electrical equipment is to allow accessibility to each part that needs inspection or adjustment, also taking into account its arrangement on board.

4.1.3 Enclosures are to be of adequate mechanical strength and rigidity.

4.1.4 Enclosures for electrical equipment are generally to be of metal; other materials may be accepted for accessories such as connection boxes, socket-outlets, switches and luminaires. Other exemptions for enclosures or parts of enclosures not made of metal will be specially considered by the Society.

4.1.5 Cable entrance are not to impair the degree of protection of the relevant enclosure.

4.1.6 All nuts and screws used in connection with current-carrying parts and working parts are to be effectively locked.

4.1.7 All equipment is generally to be provided with suitable, fixed terminal connectors in an accessible position for convenient connection of the external cables.

4.2 Degree of protection of enclosures

4.2.1 Electrical equipment is to be protected against the ingress of foreign bodies and water.

The minimum required degree of protection, in relation to the place of installation, is generally that specified in Sec 3, Tab 2.

4.2.2 The degrees of protection are to be in accordance with:

- IEC Publication No. 60529 for equipment in general
- IEC Publication No. 60034-5 for rotating machines.

SECTION 3 SYSTEM DESIGN

1 Supply systems and characteristics of the supply

1.1 Supply systems

1.1.1 The following distribution systems may be used:

a) on d.c. installations:
- two-wire insulated
- two-wire with one pole earthed

b) on a.c. installations:
- three-phase three-wire with neutral insulated
- three-phase three-wire with neutral directly earthed or earthed through an impedance
- three-phase four-wire with neutral directly earthed or earthed through an impedance
- single-phase two-wire insulated
- single-phase two-wire with one phase earthed.

1.1.2 Distribution systems other than those listed in [1.1.1] (e.g. with hull return, three-phase four-wire insulated) will be considered by the Society on a case-by-case basis.

1.1.3 The hull return system of distribution is not to be used for power, heating or lighting.

1.1.4 The requirement of [1.1.3] does not preclude under conditions approved by the Society the use of:

a) impressed current cathodic protective systems,

b) limited and locally earthed systems, or

c) insulation level monitoring devices provided the circulation current does not exceed 30 mA under the most unfavourable conditions.

Note 1: Limited and locally earthed systems such as starting and ignition systems of internal combustion engines are accepted provided that any possible resulting current does not flow directly through any dangerous spaces.

1.2 Maximum voltages

1.2.1 The maximum voltages for both alternating current and direct current low-voltage systems of supply for the yacht's services are given in Tab 1.

Table 1 : Maximum voltages for various services

Use		Maximum voltage, in V
For permanently installed and connected to fixed wiring	Power equipment	1000
	Heating equipment (except in accommodation spaces)	500
	Cooking equipment	500
	Lighting	250
	Space heaters in accommodation spaces	250
	Control **(1)**, communication (including signal lamps) and instrumentation equipment	250

(1) For control equipment which is part of a power and heating installation (e.g. pressure or temperature switches for starting/stopping motors), the same maximum voltage as allowed for the power and heating equipment may be used provided that all components are constructed for such voltage. However, the control voltage to external equipment is not to exceed 500 V.

(2) Both conductors in such systems are to be insulated from earth.

Use		Maximum voltage, in V
For permanently installed and connected by flexible cable	Power and heating equipment, where such connection is necessary because of the application (e.g. for moveable cranes or other hoisting gear)	1000
For socket-outlets supplying	Portable appliances which are not hand-held during operation (e.g. refrigerated containers) by flexible cables	1000
	Portable appliances and other consumers by flexible cables	250
	Equipment requiring extra precaution against electric shock where an isolating transformer is used to supply one appliance **(2)**	250
	Equipment requiring extra precaution against electric shock with or without a safety transformer **(2)**.	50

(1) For control equipment which is part of a power and heating installation (e.g. pressure or temperature switches for starting/stopping motors), the same maximum voltage as allowed for the power and heating equipment may be used provided that all components are constructed for such voltage. However, the control voltage to external equipment is not to exceed 500 V.

(2) Both conductors in such systems are to be insulated from earth.

1.2.2 Voltages exceeding those shown will be specially considered in the case of specific systems.

2 Sources of electrical power

2.1 General

2.1.1 Electrical installations are to be such that:

a) All electrical auxiliary services necessary for maintaining the yacht in normal operational and habitable conditions will be assured without recourse to the emergency source of electrical power.

b) Electrical services essential for safety will be assured under various emergency conditions.

c) When a.c. generators are involved, attention is to be given to the starting of squirrel-cage motors connected to the system, particularly with regard to the effect of the magnitude and duration of the transient voltage change produced due to the maximum starting current and the power factor. The voltage drop due to such starting current is not to cause any motor already operating to stall or have any adverse effect on other equipment in use.

2.2 Main source of electrical power

2.2.1 A main source of electrical power is to be provided, of sufficient capability to supply all electrical auxiliary services necessary for maintaining the yacht in normal operational and habitable conditions without recourse to the emergency source of electrical power.

2.2.2 For yachts propelled by electrical power and having two or more constant voltage propulsion generating sets which constitute the source of electrical energy for the yacht's auxiliary services, see relevant Section.

2.2.3
The main source of electrical power is to consist of at least two generating sets.

2.2.4 The arrangement of the yacht's main source of electrical power shall be such that essential services can be maintained regardless of the speed and direction of rotation of the main propulsion machinery or shafting.

2.2.5 Generators driven by the propulsion plant (shaft generators) which are intended to operate at constant speed (e.g. a system where vessel speed and direction are controlled by varying propeller pitch) may be accepted as forming part of the main source of electrical power if, in all sailing and manoeuvring conditions including the propeller being stopped, the capacity of these generators is sufficient to provide the electrical power to comply with [2.2.3] and all further requirements. They are to be not less effective and reliable than the independent generating sets.

2.3 Emergency source of electrical power

2.3.1 An emergency source of electrical power shall be provided.

2.3.2 The electrical power available shall be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously.

2.4 Measuring Instruments

2.4.1 Measuring instruments shall comply with IEC 60092-507, [4.5.6]. Multifunctional digital equipment, where practicable, can be installed, one for each power source.

3 Distribution

3.1 Earthed distribution systems

3.1.1 System earthing is to be effected by means independent of any earthing arrangements of the non-current-carrying parts.

3.1.2 Means of disconnection are to be fitted in the neutral earthing connection of each generator so that the generator may be disconnected for maintenance or insulation resistance measurements.

3.1.3 Generator neutrals may be connected in common, provided that the third harmonic content of the voltage wave form of each generator does not exceed 5%.

3.1.4 Where a switchboard is split into sections operated independently or where there are separate switchboards, neutral earthing is to be provided for each section or for each switchboard. Means are to be provided to ensure that the earth connection is not removed when generators are isolated.

3.1.5 Where for final sub-circuits it is necessary to locally connect a pole (or phase) of the sub-circuits to earth after the protective devices (e.g. in automation systems or to avoid electromagnetic disturbances), provision (e.g. d.c./d.c. convertors or transformers) is to be made such that current unbalances do not occur in the individual poles or phases.

3.2 Insulated distribution systems

3.2.1 Every insulated distribution system, whether primary or secondary , for power, heating or lighting, shall be provided with a device capable of continuously monitoring the insulation level to earth (i.e. the values of electrical insulation to earth) and of giving an audible and visual indication of abnormally low insulation values.

3.3 Distribution systems with hull return

3.3.1 Where the hull return system is used, if permitted, all final sub-circuits, i.e. all circuits fitted after the last protective device, shall be two-wire.

The hull return is to be achieved by connecting to the hull one of the busbars of the distribution board from which the final sub-circuits originate.

3.4 Supply of motors

3.4.1 A separate final sub-circuit is to be provided for every motor required for an essential service (and for every motor rated at 1 kW or more).

3.4.2 Each motor is to be provided with controlgear ensuring its satisfactory starting.

Depending on the capacity of the generating plant or the cable network, it may be necessary to limit the starting current to an acceptable value.

Direct on line starters are accepted if the voltage drop does not exceed 15% of the network voltage.

3.4.3 Efficient means are to be provided for the isolation of the motor and its associated control gear from all live poles of the supply.

Where the control gear is mounted on or adjacent to a switchboard, a disconnecting switch in the switchboard may be used for this purpose.

Otherwise, a disconnecting switch within the control gear enclosure or a separate enclosed disconnecting switch is to be provided.

3.5 Power supply to heaters

3.5.1 Each heater rated more than 16A is to be connected to a separate final circuit.

3.6 Power supply to lighting installations

3.6.1 Final sub-circuits for lighting supplying more than one lighting point and for socket-outlets are to be fitted with protective devices having a current rating not exceeding 16 A.

3.7 Navigation lights

3.7.1

Navigation lights are to be connected separately to a distribution board specially reserved for this purpose.

Signalling lights may be connected to the navigation light distribution board, or to a separate distribution board.

3.7.2

The navigation light distribution board is to be supplied from two alternative circuits, one from the main source of power and one from the emergency source of power.

The transfer of supply is to be practicable from the bridge, for example by means of a switch.

3.7.3 Each navigation light is to be controlled and protected in each insulated pole by a double-pole switch and a fuse or, alternatively, by a double-pole circuit-breaker, fitted on the distribution board referred to in [3.7.1].

3.7.4 Where there are double navigation lights, i.e. lights with two lamps or where for every navigation light a spare is also fitted, the connections to such lights may run in a single cable provided that means are foreseen in the distribution board to ensure that only one lamp or light may be supplied at any one time.

3.7.5 Each navigation light is to be provided with an automatic indicator giving audible and/or visual warning in the event of failure of the light. If an audible device alone is fitted, it is to be connected to a separate source of supply from that of the navigation lights, for example an accumulator (storage) battery.

If a visual signal is used connected in series with the navigation light, means are to be provided to prevent the extinction of the navigation light due to the failure of the visual signal.

A minimum level of visibility is to be assured in the case of use of dimmer devices.

4 Degrees of protection of the enclosures

4.1 General

4.1.1 The minimum required degree of protection for electrical equipment, in relation to the place of installation, is generally that specified in Tab 2.

4.1.2 Equipment supplied at nominal voltages in excess of 500 V and accessible to non-authorised personnel (e.g. equipment not located in machinery spaces or in locked compartments under the responsibility of the yacht's officers) is to have a degree of protection against touching live parts of at least IP4X.

4.1.3 Cables entries positioned on top of an enclosure are to be watertight (at least IP55) unless the cable entry plate or cable attachment is made so as to exclude water entry. For other positions, cable entries are to have an IP rating equal to that of the equipment.

5 Diversity (demand) factors

5.1 General

5.1.1 The cables and protective devices of final sub-circuits are to be rated in accordance with their connected load.

5.1.2 Circuits supplying two or more final sub-circuits are to be rated in accordance with the total connected load subject, where justifiable, to the application of a diversity (demand) factor.

5.1.3 A diversity (demand) factor may be applied provided that the known or anticipated operating conditions in a particular part of an installation are suitable for the application of diversity.

6 Electrical protection

6.1 General requirements for overcurrent protection

6.1.1 Electrical installations are to be protected against accidental overcurrents including short-circuit.

The choice, arrangement and performance of the various protective devices are to provide complete and coordinated automatic protection in order to ensure as far as possible:

- continuity of service in the event of a fault, through coordinated and discriminative action of the protective devices
- elimination of the effects of faults to reduce damage to the system and the hazard of fire as far as possible.

Note 1: An overcurrent is a current exceeding the nominal current.

Note 2: A short-circuit is the accidental connection by a relatively low resistance or impedance of two or more points in a circuit which are normally at different voltages.

6.1.2 Devices provided for overcurrent protection are to be chosen according to the requirements, especially with regard to overload and short-circuit.

Note 1: Overload is an operating condition in an electrically undamaged circuit which causes an overcurrent.

6.1.3 Systems are to be such as to withstand the thermal and electrodynamic stresses caused by the possible overcurrent, including short-circuit, for the admissible duration.

6.2 Short-circuit currents

6.2.1 In calculating the maximum prospective short-circuit current, the source of current is to include the maximum number of generators which can be simultaneously connected (as far as permitted by any interlocking arrangements), and the maximum number of motors which are normally simultaneously connected in the system.

The maximum number of generators or transformers is to be evaluated without taking into consideration short-term parallel operation (e.g. for load transfer) provided that suitable interlock is foreseen.

6.3 Selection of equipment

6.3.1

Circuit-breakers are to be suitable for isolation.

Circuit-breakers of withdrawable type are required where they are not suitable for isolation.

6.3.2 Equipment is to be chosen on the basis of its rated current and its making/breaking capacity.

6.3.3

In the selection of circuit-breakers with intentional short-time delay for short-circuit release (e.g. generator circuit-breakers), those of utilisation category B are to be used and they are to be selected also taking into account their rated short-time withstand current capacity (I_{cw}).

For circuit-breakers without intentional short-time delay for short-circuit release, circuit breakers of utilisation category A may be used and they are to be selected according to their rated service short-circuit breaking capacity (I_{cs}).

Note 1: For the purpose of these Rules, circuit breakers are distinguished according to the utilization categories A and B in compliance with IEC publication 60947-2 as follows:

- Utilisation category A: circuit-breakers not specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay provided for selectivity under short-circuit conditions and therefore without a short-time withstand current rating (Icw).
- Utilisation category B: circuit-breakers specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. with an intentional short-time delay (which may be adjustable) provided for selectivity under short-circuit conditions. Such circuit-breakers have a short-time withstand current rating (Icw).

6.3.4 For duplicated essential services and non-essential services, circuit-breakers may be selected according to their ultimate short-circuit breaking capacity (I_{cu}).

6.3.5

Circuit breakers used in insulated systems are to comply with Annex H of IEC Publication 60947-2.

6.3.6 For switches, the making/breaking capacity is to be in accordance with utilisation category AC-22 A or DC-22 A (in compliance with IEC Publication 60947-3).

6.3.7 For fuse-switch disconnectors or switch-disconnector fuse units, the making/breaking capacity is to be in accordance with utilisation categories AC-23 A or DC-23 A (in compliance with IEC Publication 60947-3).

6.4 Protection against short-circuit

6.4.1 Protection against short-circuit currents is to be provided by circuit- breakers or fuses.

6.4.2 The rated short-circuit breaking capacity of every protective device is to be not less than the maximum prospective value of the short-circuit current at the point of installation at the instant of contact separation.

6.4.3 The rated short-circuit making capacity of every mechanical switching device intended to be capable of being closed on short-circuit is to be not less than the maximum value of the short-circuit current at the point of installation. On alternating current this maximum value corresponds to the peak value allowing for maximum asymmetry.

6.4.4 Every protective device or contactor not intended for short-circuit interruption is to be adequate for the maximum short-circuit current liable to occur at the point of installation having regard to the time required for the short-circuit to be removed.

6.4.5 The use of a protective device not having a short-circuit breaking or making capacity at least equal to the maximum prospective short-circuit current at the point where it is installed is permitted, provided that it is backed up on the generator side by a fuse or by a circuit-breaker having at least the necessary short-circuit rating and not being the generator circuit-breaker.

6.4.6 The same fuse or circuit-breaker may back up more than one circuit-breaker where the circuits concerned do not involve essential services.

6.4.7 The short-circuit performance of the back-up arrangement is to be equal to the requirements of IEC Publication 60947-2 for a single circuit-breaker having the same short-circuit performance category as the backed-up circuit-breaker and rated for the maximum prospective short-circuit level at the supply terminals of the arrangement.

6.4.8 Circuit-breakers with fuses connected to the load side may be used, provided the back-up fuses and the circuit-breakers are of coordinated design, in order to ensure that the operation of the fuses takes place in due time so as to prevent arcing between poles or against metal parts of the circuit-breakers when they are submitted to overcurrents involving the operation of the fuse.

6.4.9 When determining the performance requirements for the above-mentioned back-up protection arrangement, it is permissible to take into account the impedance of the various circuit elements of the arrangement, such as the impedance of a cable connection when the backed-up circuit-breaker is located away from the back-up breaker or fuse.

6.5 Protection against overload

6.5.1 Devices provided for overload protection are to have a tripping characteristic (overcurrent-trip time) adequate for the overload ability of the elements of the system to be protected and for any discrimination requirements.

6.5.2 The use of fuses up to 320 A for overload protection is permitted.

6.6 Localisation of overcurrent protection

6.6.1 Short-circuit protection is to be provided for every non-earthed conductor.

6.6.2 Overload protection is to be provided for every non-earthed conductor; nevertheless, in insulated single-phase circuits or insulated three-phase circuits having substantially balanced loads, the overload protection may be omitted on one conductor.

6.6.3 Short-circuit and overload protective devices are not to interrupt earthed conductors, except in the case of multiple disconnection devices which simultaneously interrupt all the conductors, whether earthed or not.

6.6.4 Electrical protection is to be located as close as possible to the origin of the protected circuit.

6.7 Protection of generators

6.7.1 Generators are to be protected against short-circuits and overloads by multipole circuit-breakers.

For generators not arranged to operate in parallel with a rated output equal to or less than 50 kVA, a multipole switch with a fuse in each insulated phase on the generator side may be accepted.

6.7.2 When multipole switch and fuses are used, the fuse rating is to be maximum 110% of the generator rated current.

6.7.3 For emergency generators the overload protection may, instead of disconnecting the generator automatically, give a visual and audible alarm in a permanently attended space.

6.7.4 After disconnection of a generator due to overload, the circuit-breaker is to be ready for immediate reclosure.

6.7.5 Generator circuit-breakers are to be provided with a reclosing inhibitor which prevents their automatic reclosure after tripping due to a short-circuit.

6.7.6 Alternating current generators arranged to operate in parallel are to be provided with reverse-power protection.

The protection is to be selected in accordance with the characteristics of the prime mover.

The following values are recommended:

- 2-6% of the rated power for turbogenerators
- 8-15% of the rated power for diesel generators.

The reverse-power protection may be replaced by other devices ensuring adequate protection of the prime movers.

6.7.7 Generators are to be provided with an undervoltage protection which trips the breaker if the voltage falls to 70% - 35% of the rated voltage.

For generators arranged for parallel operation, measures are to be taken to prevent the generator breaker from closing if the generator is not generating and to prevent the generator remaining connected to the busbars if voltage collapses.

The operation of the undervoltage release is to be instantaneous when preventing closure of the breaker, but it is to be delayed for selectivity purposes when tripping the breaker.

6.8 Protection of circuits

6.8.1 Each separate circuit shall be protected against short-circuit and against overload, unless otherwise specified in these Rules or where the Society may exceptionally otherwise permit.

6.8.2 Each circuit is to be protected by a multipole circuit-breaker or switch and fuses against overloads and short-circuits.

6.8.3 Circuits for lighting are to be disconnected on both non-earthed conductors; single-pole disconnection of final sub-circuits with both poles insulated is permitted only in accommodation spaces.

6.8.4 The protective devices of the circuits supplying motors are to allow excess current to pass during transient starting of motors.

6.8.5 Final sub-circuits which supply one consumer with its own overload protection (for example motors), or consumers which cannot be overloaded (for example permanently wired heating circuits and lighting circuits), may be provided with short-circuit protection only.

6.8.6 Steering gear circuits are to be provided with short-circuit protection only.

6.9 Protection of motors

6.9.1 Motors of rating exceeding 1 kW and all motors for essential services are to be protected individually against overload and short-circuit. The short-circuit protection may be provided by the same protective device for the motor and its supply cable (see [6.9.5]).

6.9.2 For motors intended for essential services, the overload protection may be replaced by an overload alarm.

6.9.3 The protective devices are to be designed so as to allow excess current to pass during the normal accelerating period of motors according to the conditions corresponding to normal use.

If the current/time characteristic of the overload protection device does not correspond to the starting conditions of a motor (e.g. for motors with extra-long starting period), provision may be made to suppress operation of the device during the acceleration period on condition that the short-circuit protection remains operative and the suppression of overload protection is only temporary.

6.9.4 For continuous duty motors the protective gear is to have a time delay characteristic which ensures reliable thermal protection against overload.

6.9.5 The protective devices are to be adjusted so as to limit the maximum continuous current to a value within the range 105% - 120% of the motor's rated full load current.

6.9.6 For intermittent duty motors the current setting and the delay (as a function of time) of the protective devices are to be chosen in relation to the actual service conditions of the motor.

6.9.7 Where fuses are used to protect polyphase motor circuits, means are to be provided to protect the motor against unacceptable overload in the case of single phasing.

6.9.8 The automatic restart of a motor is not to produce a starting current such as to cause excessive voltage drop.

In the case of several motors required to restart automatically, the total starting current is not to cause an excessive voltage drop or sudden surge current; to this end, it may be necessary to achieve a sequence start.

6.9.9 The undervoltage protective devices are to allow the motor to be started when the voltage exceeds 85% of the rated voltage and are to intervene without fail when the voltage drops to less than approximately 20% of the rated voltage, at the rated frequency and with a time delay as necessary.

6.10 Protection of storage batteries

6.10.1 Batteries are to be protected against overload and short-circuit by means of fuses or multipole circuit-breakers at a position adjacent to the battery compartment.

Overcurrent protection may be omitted for the circuit to the starter motors when the current drawn is so large that is impracticable to obtain short-circuit protection.

6.10.2 Emergency batteries supplying essential services are to have short-circuit protection only.

6.11 Protection of shore power connection

6.11.1 Permanently fixed cables connecting the shore connection box to the main switchboard are to be protected by fuses or circuit-breakers.

6.12 Protection of measuring instruments, pilot lamps and control circuits

6.12.1 Measuring circuits and devices (voltage transformers, voltmeters, voltage coils of measuring instruments, insulation monitoring devices etc.) and pilot lamps are to be protected against short-circuit by means of multipole circuit-breakers or fuses.

The protective devices are to be placed as near as possible to the tapping from the supply.

The secondary side of current transformers is not to be protected.

6.12.2 Control circuits and control transformers are to be protected against overload and short-circuit by means of multipole circuit-breakers or fuses on each pole not connected to earth.

Overload protection may be omitted for transformers with a rated current of less than 2 A on the secondary side.

The short-circuit protection on the secondary side may be omitted if the transformer is designed to sustain permanent short-circuit current.

6.12.3 Where a fault in a pilot lamp would impair the operation of essential services, such lamps are to be protected separately from other circuits such as control circuits.

Note 1: Pilot lamps connected via short-circuit-proof transformers may be protected in common with control circuits.

6.12.4 Circuits whose failure could endanger operation, such as steering gear control feeder circuits, are to be protected only against short-circuit.

6.12.5 The protection is to be adequate for the minimum cross-section of the protected circuits.

6.13 Protection of transformers

6.13.1 The primary winding side of power transformers is to be protected against short-circuit and overload by means of multipole circuit-breakers or switches and fuses.

Overload protection on the primary side may be dispensed with where it is provided on the secondary side or when the total possible load cannot reach the rated power of the transformer.

6.13.2 The protection against short-circuit is to be such as to ensure the selectivity between the circuits supplied by the secondary side of the transformer and the feeder circuit of the transformer.

6.13.3 When transformers are arranged to operate in parallel, means are to be provided so as to trip the switch on the secondary winding side when the corresponding switch on the primary side is open.

7 System components

7.1 General

7.1.1 The components of the electrical system are to be dimensioned such as to withstand the currents that can pass through them during normal service without their rating being exceeded.

7.1.2 The components of the electrical system are to be designed and constructed so as to withstand for the admissible duration the thermal and electrodynamic stresses caused by possible overcurrents, including short-circuit.

8 Electrical cables

8.1 General

8.1.1
As an alternative to [8] the use of cables in accordance with paragraphs from 17 to 21 of the EN/ ISO 13297 may be evaluated.

8.1.2 All electrical cables and wiring external to equipment shall be at least of a flame-retardant type, in accordance with IEC Publication 60332-1.

8.1.3 In addition to the provisions of [8.1.1], when cables are laid in bundles, cable types are to be chosen in compliance with IEC Publication 60332-3 Category A, or other means are to be provided such as not to impair their original flame-retarding properties.

8.1.4 Where necessary for specific applications such as radio frequency or digital communication systems, which require the use of particular types of cables, the Society may permit the use of cables which do not comply with the provisions of [8.1.1] and [8.1.2].

8.1.5
Cables which are required to have fire-resisting characteristics are to comply with the requirements stipulated in [8.6].

8.2 Choice of insulation

8.2.1 The maximum rated operating temperature of the insulating material is to be at least 10°C higher than the maximum ambient temperature liable to occur or to be produced in the space where the cable is installed.

8.2.2 The maximum rated conductor temperature for normal and short-circuit operation, for the type of insulating compounds normally used for board cables, is not to exceed the values stated in Tab 3. Special consideration will be given to other insulating materials.

8.2.3 PVC insulated cables are not to be used either in refrigerated spaces, or on decks exposed to the weather of yachts classed for unrestricted service.

8.2.4 Mineral insulated cables will be considered on a case-by-case basis.

8.3 Choice of protective covering

8.3.1 The conductor insulating materials are to be enclosed in an impervious sheath of material appropriate to the expected ambient conditions where cables are installed in the following locations:

- on decks exposed to the weather,
- in damp or wet spaces (e.g. in bathrooms),
- in refrigerated spaces,
- in machinery spaces and, in general,
- where condensation water or harmful vapour may be present.

8.3.2 Where cables are provided with armour or metallic braid (e.g. for cables installed in hazardous areas), an overall impervious sheath or other means to protect the metallic elements against corrosion is to be provided; see Sec 9, [1.5].

8.3.3 An impervious sheath is not required for single-core cables installed in tubes or ducts inside accommodation spaces, in circuits with maximum system voltage 250 V.

8.3.4 In choosing different types of protective coverings, due consideration is to be given to the mechanical action to which each cable may be subjected during installation and in service.

If the mechanical strength of the protective covering is considered insufficient, the cables are to be mechanically protected (e.g. by an armour or by installation inside pipes or conduits).

8.3.5 Single-core cables for a.c. circuits with rated current exceeding 20 A are to be either non-armoured or armoured with non-magnetic material.

8.4 Cables in refrigerated spaces

8.4.1 Cables installed in refrigerated spaces are to have a watertight or impervious sheath and are to be protected against mechanical damage. If an armour is applied on the sheath, the armour is to be protected against corrosion by a further moisture-resisting covering.

8.5 Electrical services required to be operable under fire conditions and fire-resistant cables

8.5.1

Electrical services required to be operable under fire conditions are as follows:

8.5.1 Control and power systems to power-operated fire doors and status indication for all fire doors

8.5.2 Control and power systems to power-operated watertight doors and their status indication

8.5.3 Emergency fire pump

8.5.4 Emergency lighting

8.5.5 Fire and general alarms

8.5.6 Fire detection systems

8.5.7 Fire-extinguishing systems and fire-extinguishing media release alarms

8.5.8 Low location lighting

8.5.9 Public address systems

8.5.10 Remote emergency stop/shutdown arrangements for systems which may support the propagation of fire and/or explosion.

8.5.2

The electrical cables to the emergency fire pump are not to pass through the machinery spaces containing the main fire pumps and their source(s) of power and prime mover(s).

8.6 Cables for submerged bilge pumps

8.6.1 Cables and their connections to such pumps are to be capable of operating under a head of water equal to their distance below the bulkhead deck. The cable is to be impervious-sheathed and armoured, is to be installed in continuous lengths from above the bulkhead to the motor terminals and is to enter the air bell from the bottom.

8.7 Internal wiring of switchboards and other enclosures for equipment

8.7.1 For installation in switchboards and other enclosures for equipment, single-core cables may be used without further protection (sheath).

Other types of flame-retardant switchboard wiring may be accepted at the discretion of the Society.

8.8 Current carrying capacity of cables

8.8.1 The current carrying capacity for continuous service of cables given in Tab 4 to Tab 8 is based on the maximum permissible service temperature of the conductor also indicated therein and on an ambient temperature of 45°C.

8.8.2 The current carrying capacity cited in [9.9.1] is applicable, with rough approximation, to all types of protective covering (e.g. both armoured and non-armoured cables).

8.8.3 Values other than those shown in Tab 4 to Tab 8 may be accepted provided they are determined on the basis of calculation methods or experimental values approved by the Society.

8.8.4 When the actual ambient temperature obviously differs from 45°C, the correction factors shown in Tab 9 may be applied to the current carrying capacity in Tab 4 to Tab 8.

8.8.5 Where more than six cables are bunched together in such a way that there is an absence of free air circulating around them, and the cables can be expected to be under full load simultaneously, a correction factor of 0,85 is to be applied.

Table 2 : Maximum rated conductor temperature

Type of insulating compound	Abbreviated designation	Maximum rated conductor temperature, in °C	
		Normal operation	Short-circuit
a) Thermoplastic:			
- based upon polyvinyl chloride or copolymer of vinyl chloride and vinyl acetate	PVC	70	150
b) Elastomeric or thermosetting:			
- based upon ethylene-propylene rubber or similar (EPM or EPDM)	EPR	90	250
- based upon high modulus or hardgrade ethylene propylene rubber	HEPR	90	250
- based upon cross-linked polyethylene	XLPE	90	250
- based upon rubber silicon	S 95	95	350(2)
- based upon ethylene-propylene rubber or similar (EPM or EPDM) halogen free	HF EPR	90	250 (2)
- based upon high modulus or hardgrade halogen free ethylene propylene rubber	HF HEPR	90	250
- based upon cross-linked polyethylene halogen free	HF XLPE	90	250
- based upon rubber silicon halogen free	HF S 95	95	350
- based upon cross-linked polyolefin material for halogen free cable **(1)**	HF 90	90	250

(1) Used on sheathed cable only

(2) This temperature is applicable only to power cables and not appropriate for tinned copper conductors

Table 3 : Current carrying capacity, in A in continuous service for cables based on maximum conductor operating temperature of 60°C (ambient temperature 45°C)

Nominal section mm^2	Number of conductors		
	1	2	3 or 4
1,5	10	9	7
2,5	17	14	12
4	232	20	16
6	29	25	20
10	40	34	28
16	54	46	38
25	71	60	50
35	88	75	62
50	110	94	77
70	135	115	95
95	164	139	115
120	189	161	132
150	218	185	153
185	248	211	174
240	292	248	204
300	336	286	235
400	d.c.:390 a.c.:380	d.c.:332 a.c.:323	d.c.:273 a.c.:266

Nominal section mm²	Number of conductors		
	1	2	3 or 4
500	d.c.:450 a.c.:430	d.c.:383 a.c.:366	d.c.:315 a.c.:301
600	d.c.:520 a.c.:470	d.c.:442 a.c.:400	d.c.:364 a.c.:329

Table 4 : Current carrying capacity, in A in continuous service for cables based on maximum conductor operating temperature of 70°C (ambient temperature 45°C)

Nominal section mm²	Number of conductors		
	1	2	3 or 4
1,5	15	13	11
2,5	21	18	15
4	29	25	20
6	37	31	26
10	51	43	36
16	68	58	48
25	90	77	63
35	111	94	78
50	138	117	97
70	171	145	120
95	207	176	145
120	239	203	167
150	275	234	193
185	313	266	219
240	369	314	258
300	424	360	297
400	d.c.:500 a.c.:490	d.c.:425 a.c.:417	d.c.:350 a.c.:343
500	d.c.:580 a.c.:550	d.c.:493 a.c.:468	d.c.:406 a.c.:385
600	d.c.:670 a.c.:610	d.c.:570 a.c.:519	d.c.:467 a.c.:427

Table 5 : Current carrying capacity, in A in continuous service for cables based on maximum conductor operating temperature of 85°C (ambient temperature 45°C)

Nominal section mm²	Number of conductors		
	1	2	3 or 4
1,5	21	8	5
2,5	28	24	20
4	38	32	27
6	49	42	34
10	67	57	47
16	91	77	64
25	120	102	84
35	148	126	104
50	184	156	129

Nominal section mm^2	Number of conductors		
	1	2	3 or 4
70	228	194	160
95	276	235	193
120	319	271	223
150	367	312	257
185	418	355	293
240	492	418	344
300	565	408	396
400	d.c.:650 a.c.:630	d.c.:553 a.c.:536	d.c.:455 a.c.:441
500	d.c.:740 a.c.:680	d.c.:629 a.c.:578	d.c.:518 a.c.:476
600	d.c.:840 a.c.:740	d.c.:714 a.c.:629	d.c.:588 a.c.:518

Table 6 : Current carrying capacity, in A in continuous service for cables based on maximum conductor operating temperature of 90°C (ambient temperature 45°C)

Nominal section mm^2	Number of conductors		
	1	2	3 or 4
1,5	23	20	16
2,5	40	26	21
4	51	34	28
6	52	44	36
10	72	16	50
16	96	82	67
25	127	108	89
35	157	133	110
50	196	167	137
70	242	206	169
95	293	249	205
120	339	288	237
150	389	331	272
185	444	377	311
240	522	444	365
300	601	511	421
400	d.c.:690 a.c.:670	d.c.:587 a.c.:570	d.c.:483 a.c.:469
500	d.c.:780 a.c.:720	d.c.:663 a.c.:612	d.c.:546 a.c.:504
600	d.c.:890 a.c.:780	d.c.:757 a.c.:663	d.c.:623 a.c.:546

Table 7 : Current carrying capacity, in A in continuous service for cables based on maximum conductor operating temperature of 95°C (ambient temperature 45°C)

Nominal section mm^2	Number of conductors		
	1	2	3 or 4
1,5	26	22	18
2,5	32	27	22
4	43	37	30
6	55	47	39
10	76	65	53
16	102	87	71
25	135	115	95
35	166	141	116
50	208	177	140
70	256	218	179
95	310	264	217
120	359	305	251
150	412	350	288
185	470	400	329
240	535	470	387
300	636	541	445
400	d.c.:760 a.c.:725	d.c.:646 a.c.:616	d.c.:532 a.c.:508
500	d.c.:875 a.c.:810	d.c.:744 a.c.:689	d.c.:612 a.c.:567
600	d.c.:1010 a.c.:900	d.c.:859 a.c.:765	d.c.:707 a.c.:630

8.8.6 Where a cable is intended to supply a short-time load for 1/2-hour or 1-hour service (e.g. mooring winches or bow thruster propellers), the current carrying capacity obtained from Tab 4 to Tab 8 may be increased by applying the corresponding correction factors given in Tab 10.

In no case is a period shorter than 1/2-hour to be used, whatever the effective period of operation.

8.8.7 For supply cables to single services for intermittent loads, the current carrying capacity obtained from Tab 4 to Tab 8 may be increased by applying the correction factors given in Tab 11.

The correction factors are calculated with rough approximation for periods of 10 minutes, of which 4 minutes with a constant load and 6 minutes without load.

8.9 Minimum nominal cross-sectional area of conductors

8.9.1 In general the minimum allowable conductor cross-sectional areas are those given in Tab 12.

8.9.2 The nominal cross-sectional area of the neutral conductor in three-phase distribution systems is to be equal to at least 50% of the cross-sectional area of the phases, unless the latter is less than or equal to 16 mm^2. In such case the cross-sectional area of the neutral conductor is to be equal to that of the phase.

8.10 Choice of cables

8.10.1 The rated voltage of any cable is to be not lower than the nominal voltage of the circuit for which it is used.

8.10.2 The nominal cross-sectional area of each cable is to be sufficient to satisfy the following conditions with reference to the maximum anticipated ambient temperature:

- the current carrying capacity is to be not less than the highest continuous load carried by the cable
- the voltage drop in the circuit, by full load on this circuit, is not to exceed the specified limits

- the cross-sectional area calculated on the basis of the above is to be such that the temperature increases which may be caused by overcurrents or starting transients do not damage the insulation.

8.10.3 The highest continuous load carried by a cable is to be calculated on the basis of the power requirements and of the diversity factor of the loads and machines supplied through that cable.

8.10.4 When the conductors are carrying the maximum nominal service current, the voltage drop from the main or emergency switchboard busbars to any point in the installation is not to exceed 6% of the nominal voltage.

For battery circuits with supply voltage less than 55 V, this value may be increased to 10%.

For the circuits of navigation lights, the voltage drop is not to exceed 5% of the rated voltage under normal conditions.

Table 8 : Correction factors for various ambient air temperatures (Reference ambient temperature of 45°C)

Maximum conductor temperature, in °C	Correction factors for ambient air temperature of :										
	35°C	40°C	45°C	50°C	55°C	60°C	65°C	70°C	75°C	80°C	85°C
60	1,29	1,15	1,00	0,82	-	-	-	-	-	-	-
65	1.22	1.12	1.00	0.87	0.71	-	-	-	-	-	-
70	1.18	1.10	1.00	0.89	0.77	0.63	-	-	-	-	-
75	1,15	1,08	1,00	0,91	0,82	0,71	0,58	-	-	-	-
80	1,13	1,07	1,00	0,93	0,85	0,76	0,65	0,53	-	-	-
85	1,12	1,06	1,00	0,94	0,87	0,79	0,71	0,61	0,50	-	-
90	1.10	1.05	1.00	0.94	0.88	0.82	0.74	0.67	0.58	0.47	-
95	1,10	1,05	1,00	0,95	0,89	0,84	0,77	0,71	0,63	0,55	0,45

Table 9 : Correction factors for short-time loads

½ -hour service		1-hour service		
Sum of nominal cross-sectional areas of all conductors in the cable, in mm^2		Sum of nominal cross-sectional areas of all conductors in the cable, in mm^2		Correlation factor
Cables with metallic sheath and armoured cables	Cables with non-metallic sheath and non-armoured cables	Cables with metallic sheath and armoured cables	Cables with non-metallic sheath and non-armoured cables	
up to 20	up to 75	up to 80	up to 230	1,06
21-41	76-125	81-170	231-400	1,10
41-65	126-180	171-250	401-600	1,15
66-95	181-250	251-430	601-800	1,20
96-135	251-320	431-600	-	1,25
136-180	321-400	601-800	-	1,30
181-235	401-500	-	-	1,35
236-285	501-600	-	-	1,40
286-350	-	-	-	1,45

Table 10 : Correction factors for intermittent service

Sun of nominal cross selectionel areas of all conductors in the cable, in mm^2		Correction factor
Cables with metallic sheath and armoured cables	Cables without metallic sheath and non-amoured cables	
	$S \leq 5$	1,10
	$5 < S \leq 8$	1,15
	$8 < S \leq 16$	1,20

Sun of nominal cross selectionel areas of all conductors in the cable, in mm^2		Correction factor
Cables with metallic sheath and armoured cables	Cables without metallic sheath and non-amoured cables	
$S \leq 4$	$16 < S \leq 825$	1,25
$4 < S \leq 7$	$25 < S \leq 42$	1,30
$7 < S \leq 17$	$42 < S \leq 72$	1,35
$17 < S \leq 42$	$72 < S \leq 140$	1,40
$42 < S \leq 110$	$140 < S$	1,45
$110 < S$	-	1,50

8.10.5 T9.11.4 Cables with conductors of cross-section less than 10 mm^2 are not to be connected in parallel.

9 Recording of the Type, Location and Maintenance Cycle of Batteries

9.1 Battery schedule

9.1.1

Where batteries are fitted for use for essential and emergency services, a schedule of such batteries is to be compiled and maintained. The schedule, required in Sec 1, Tab 1, is to include at least the following information regarding the battery(ies):

9.1.1 type and Manufacturer's type designation

9.1.2 voltage and ampere-hour rating

9.1.3 location

9.1.4 equipment and/or system(s) served

9.1.5 maintenance/replacement cycle dates

9.1.6 date(s) of last maintenance and/or replacement

9.1.7 for replacement batteries in storage, the date of manufacture and shelf life.

Note 1: Shelf life is the duration of storage under specified conditions at the end of which a battery retains the ability to give a specified performance.

SECTION 4 STORAGE BATTERIES, CHARGERS, UNINTERRUPTIBLE POWER SYSTEMS AND FUEL CELLS

1 Constructional requirements for batteries

1.1 General

1.1.1 The requirements of this Article apply to permanently installed storage batteries (not to portable batteries).

1.1.2

Storage batteries may be of the lead-acid or nickel-alkaline type, due consideration being given to the suitability for any specific application.

The use of batteries other than Lead-acid or alkaline batteries is allowed subject to the compliance of the battery system and its installation to the requirements given in the relevant Appendix.

Storage batteries of satisfactorily proven design (e.g. silver/zinc) may be accepted provided they are suitable for board use to the satisfaction of the Society.

1.1.3 Cells are to be assembled in suitable crates or trays equipped with handles for convenient lifting.

1.2 Vented batteries

1.2.1 Vented batteries are those in which the electrolyte can be replaced and freely releases gas during periods of charge and overcharge.

1.2.2 Vented batteries are to be constructed to withstand the movement of the yacht and the atmosphere (salt mist, oil etc.) to which they may be exposed.

1.2.3 Battery cells are to be so constructed as to prevent spilling of electrolyte at any inclination of the battery up to 40° from the vertical.

1.2.4 It is to be possible to check the electrolyte level and the pH.

1.3 Valve-regulated sealed batteries

1.3.1 Valve-regulated sealed batteries are batteries whose cells are closed under normal conditions but which have an arrangement which allows the escape of gas if the internal pressure exceeds a predetermined value. The cells cannot normally receive addition to the electrolyte.

Note 1: The cells of batteries which are marketed as “sealed” or “maintenance free” are fitted with a pressure relief valve as a safety precaution to enable uncombined gas to be vented to the atmosphere; they should more properly be referred to as valve-regulated sealed batteries. In some circumstances the quantity of gas vented can be up to 25% of the equivalent vented design. The design is to take into consideration provision for proper ventilation.

1.3.2 Cell design is to minimise risks of release of gas under normal and abnormal conditions.

1.4 Tests on batteries

1.4.1 The battery autonomy is to be verified on board in accordance with the operating conditions.

2 Constructional requirements for chargers

2.1 Characteristics

2.1.1 Chargers are to be adequate for the batteries for which they are intended and provided with a voltage regulator.

2.1.2 In the absence of indications regarding its operation, the battery charger is to be such that the completely discharged battery can be recharged to 80% capacity within a period of 10 hours without exceeding the maximum permissible charging current. A charging rate other than the above (e.g. fully charged within 6 hours for batteries for starting of motors) may be required in relation to the use of the battery.

2.1.3 For floating service or for any other condition where the load is connected to the battery while it is on charge, the maximum battery voltage is not to exceed the safe value of any connected apparatus.

Note 1: Consideration is to be given to the temperature variation of the batteries.

2.1.4 The battery charger is to be designed so that the charging current is set within the maximum current allowed by the manufacturer when the battery is discharged and the floating current to keep the battery fully charged.

2.1.5 Trickle charging to neutralise internal losses is to be provided. An indication is to be provided to indicate a charging voltage being present at the charging unit.

2.1.6 Protection against reversal of the charging current is to be provided.

2.1.7 Battery chargers are to be constructed to simplify maintenance operation. Indications are to be provided to visualise the proper operation of the charger and for troubleshooting.

3 Fuel cells

3.1 General

3.1.1

The requirements of this Article apply to fuel cells installed on board.

3.1.2

The use of fuel cells is allowed subject to the compliance of the fuel cell power installation to the requirements given in the relevant appendix.

SECTION 5 LOCATION

1 General

1.1 Location

1.1.1 The degree of protection of the enclosures and the environmental categories of the equipment are to be appropriate to the spaces or areas in which they are located.

2 Distribution boards

2.1 Distribution board for navigation lights

2.1.1 The distribution board for navigation lights is to be placed in an accessible position on the bridge.

3 Cable runs

3.1 General

3.1.1 Cable runs are to be selected so as to be as far as practicable accessible, with the exception of single cables, situated behind walls or ceilings constructed of incombustible materials, supplying lighting fittings and socket-outlets in accommodation spaces, or cables enclosed in pipes or conduits for installation purposes.

3.1.2 Cable runs are to be selected so as to avoid action from condensed moisture and from dripping of liquids.

3.1.3 Connection and draw boxes are to be accessible.

3.1.4 Cables are generally not to be installed across expansion joints.

Where this is unavoidable, however, a loop of cable of length proportional to the expansion of the joint is to be provided.

3.2 Location of cables in relation to electromagnetic interference

3.2.1 For the installation of cables in the vicinity of radio equipment or of cables belonging to electronic control and monitoring systems, steps are to be taken in order to limit the effects of unwanted electromagnetic interference.

4 Storage batteries

4.1 General

4.1.1 Batteries are to be located where they are not exposed to excessive heat, extreme cold, spray, steam or other conditions which would impair performance or accelerate deterioration. They are to be installed in such a way that no damage may be caused to surrounding appliances by the vapours generated.

4.1.2 Storage batteries are to be suitably housed, and compartments (rooms, lockers or boxes) used primarily for their accommodation are to be properly constructed and efficiently ventilated so as to prevent accumulation of flammable gas.

4.1.3 Starter batteries are to be located as close as practicable to the engine or engines served.

4.1.4 Accumulator batteries shall not be located in sleeping quarters except where hermetically sealed to the satisfaction of the Society.

4.1.5 Lead-acid batteries and alkaline batteries are not to be installed in the same compartment (room, locker, box), unless of valve-regulated sealed type.

4.2 Large vented batteries

4.2.1 Batteries connected to a charging device of power exceeding 2 kW, calculated from the maximum obtainable charging current and the nominal voltage of the battery (hereafter referred to as "large batteries") are to be installed in a room assigned to batteries only.

Where this is not possible, they may be arranged in a suitable locker on deck.

4.2.2 Rooms assigned to large batteries are to be provided with mechanical exhaust ventilation.

Natural ventilation may be employed for boxes located on open deck.

4.2.3 The provisions of [4.2.1] and [4.2.2] also apply to several batteries connected to charging devices of total power exceeding 2 kW calculated for each one as stated in [4.2.1].

4.3 Moderate vented batteries

4.3.1 Batteries connected to a charging device of power between 0,2 kW and 2 kW calculated as stated in [6.2.1] (hereafter referred to as "moderate batteries") are to be arranged in the same manner as large batteries or placed in a box or locker in suitable locations such as machinery spaces, storerooms or similar spaces. In machinery spaces and similar well-ventilated compartments, these batteries may be installed without a box or locker provided they are protected from falling objects, dripping water and condensation where necessary.

4.3.2 Rooms, lockers or boxes assigned to moderate batteries are to be provided with natural ventilation or mechanical exhaust ventilation, except for batteries installed without a box or locker (located open) in well-ventilated spaces.

4.3.3 The provisions of [4.3.1] and [4.3.2] also apply to several batteries connected to charging devices of total power between 0,2 kW and 2 kW calculated for each one as stated in [4.2.1].

4.4 Small vented batteries

4.4.1 Batteries connected to a charging device of power less than 0,2 kW calculated as stated in [4.2.1] (hereafter referred to as "small batteries") are to be arranged in the same manner as moderate or large batteries, or without a box or locker, provided they are protected from falling objects, or in a box in a ventilated area.

4.4.2 Boxes for small batteries may be ventilated only by means of openings near the top to permit escape of gas.

4.5 Ventilation

4.5.1 The ventilation of battery compartments is to be independent of ventilation systems for other spaces.

4.5.2 The quantity of air expelled (by natural or forced ventilation) for compartments containing vented type batteries is to be at least equal to:

$$Q = 110 \cdot I \cdot n$$

where:

Q : Quantity of air expelled, in litres per hour

I : Maximum current delivered by the charging equipment during gas formation, but not less than one quarter of the maximum obtainable charging current in amperes

n : Number of cells in series.

4.5.3 The quantity of air expelled (by natural or forced ventilation) for compartments containing valve-regulated sealed batteries is to be at least 25% of that given in [4.5.2].

4.5.4 Ducts are to be made of a corrosion-resisting material or their interior surfaces are to be painted with corrosion-resistant paint.

4.5.5 Adequate air inlets (whether connected to ducts or not) are to be provided near the floor of battery rooms or the bottom of lockers or boxes (except for that of small batteries).

Air inlet may be from the open air or from another space (for example from machinery spaces).

4.5.6 Exhaust ducts of natural ventilation systems:

a) are to be run directly from the top of the compartment to the open air above (they may terminate in the open or in well-ventilated spaces)

b) are to terminate not less than 90 cm above the top of the battery compartment

c) are to have no part more than 45° from the vertical

d) are not to contain appliances (for example for barring flames) which may impede the free passage of air or gas mixtures.

Where natural ventilation is impracticable or insufficient, mechanical exhaust ventilation is to be provided.

4.5.7 In mechanical exhaust ventilation systems:

a) electric motors are to be outside the exhaust ducts and battery compartment and are to be of safe type if installed within 3 m from the exhaust of the ventilation duct

b) fans are to be so constructed and of a material such as to render sparking impossible in the event of the impeller touching the fan casing

c) steel or aluminium impellers are not to be used

d) the system is to be interlocked with the charging device so that the battery cannot be charged without ventilation (trickle charge may be maintained)

e) a temperature sensor is to be located in the battery compartment to monitor the correct behaviour of the battery in cases where the battery element is sensitive to temperature.

4.5.8 For natural ventilation systems for deck boxes:

a) holes for air inlet are to be provided on at least two opposite sides of the box

b) the exhaust duct is to be of ample dimensions

c) the duct is to terminate at least 1,25 m above the box in a goose-neck or mushroom-head or the equivalent

d) the degree of protection is to be in accordance with Sec 3, Tab 2.

SECTION 6 INSTALLATION

1 General

1.1 Protection against injury or damage caused by electrical equipment

1.1.1 All electrical equipment is to be so installed as not to cause injury when handled or touched in the normal manner.

1.1.2 All electrical equipment is to be installed in such a way that live parts cannot be inadvertently touched, unless supplied at a safety voltage.

1.1.3 For protective earthing as a precaution against indirect contact, see [2].

1.1.4 Equipment is to be installed so as not to cause, or at least so as to reduce to a minimum, electromagnetic interference.

1.2 Protection against damage to electrical equipment

1.2.1 Electrical equipment is to be so placed that as far as practicable it is not exposed to risk of damage from water, steam, oil or oil vapours.

1.2.2 The air supply for internal ventilation of electrical equipment is to be as clean and dry as practicable; cooling air for internal ventilation is not to be drawn from below the floor plates in engine .

1.2.3 Equipment is to be so mounted that its enclosing arrangements and the functioning of the built-in equipment will not be affected by distortions, vibrations and movements of the yacht's structure or by other damage liable to occur.

1.2.4 If electrical fittings, not of aluminium, are attached to aluminium, suitable provision is to be made to prevent galvanic corrosion.

1.3 Accessibility

1.3.1 Equipment is to be so installed that sufficient space is available for inspection and maintenance as required for all its parts.

2 Earthing of non-current carrying parts

2.1 Parts which are to be earthed

2.1.1 Exposed metal parts of both fixed and portable electrical machines or equipment which are not intended to be live but which are liable under fault conditions to become live and similar metal parts inside non-metallic enclosures are to be earthed unless the machines or equipment are:

a) supplied at a voltage not exceeding 50 V direct current or 50 V, root mean square between conductors, achieved without the use of auto-transformers (safety voltage); or

b) supplied at a voltage not exceeding 250 V by safety isolating transformers supplying one consuming device only; or

c) constructed in accordance with the principle of double insulation.

2.1.2 To minimise shock from high frequency voltage induced by the radio transmitter, handles, handrails and other metal elements on the bridge or upper decks are to be in electrical connection with the hull or superstructures.

2.2 Methods of earthing

2.2.1 Metal frames or enclosures of apparatus and electrical machinery may be fixed to, and in metallic contact with, the yacht's structure, provided that the surfaces in contact are clean and free from rust, scale or paint when installed and are firmly bolted together.

2.2.2 For metal frames or enclosures which are not earthed as specified in [2.2.1], earthing connections complying with [2.3] and [2.4] are to be used.

2.2.3 For requirements regarding the earthing of coverings of cables and the mechanical protection of cables, see [7.11] and [7.12].

2.3 Earthing connections

2.3.1 Every earthing connection is to be of copper or other corrosion-resistant material and is to be securely installed and protected, where necessary, against damage and electrolytic corrosion.

2.3.2 The nominal cross-sectional area of each copper earthing connection is to be not less than that required in Tab 1.

Earthing connections of other metals are to have conductance at least equal to that specified for a copper earthing connection.

Table 1 : Cross-sectional area of earth-continuity conductors and earthing connections

<table>
<tr><th colspan="2">Type of earthing connection</th><th>Cross-sectional area of associated current carrying conductor</th><th>Minimum cross-sectional area of copper earthing connection</th></tr>
<tr><td>1</td><td>Earth-continuity conductor in flexible cable or flexible cord</td><td>any</td><td>Same as current carrying conductor up to and including 16 mm^2 and one half above 16 mm^2 but at least 16 mm^2</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Earth-continuity conductor incorporated in fixed cable</td><td rowspan="4">any</td><td>a) for cables having an insulated earth-continuity conductor
• a cross-section equal to the main conductors up to and including 16 mm^2, but minimum 1,5 mm^2
• a cross-section not less than 50% of the cross-section of the main conductor when the latter is more than 16 mm^2, but at least 16 mm^2
b) for cables with a bare earth wire in direct contact with the lead sheath</td></tr>
<tr><td>Cross-section of main conductor
mm^2</td><td>Earthing connection
mm^2</td></tr>
<tr><td>1 ÷ 2,5
4 ÷ 6</td><td>1
1,5</td></tr>
<tr><td></td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Separate fixed earthing conductor</td><td>≤ 2,5 mm^2</td><td>Same as current carrying conductor subject to minimum of 1,5 mm^2 for stranded earthing connection or 2,5 mm^2 for unstranded earthing connection</td></tr>
<tr><td>> 2,5 mm^2 but ≤ 120 mm^2</td><td>One half the cross-sectional area of the current carrying conductor, subjected to a minimum of 4 mm^2</td></tr>
<tr><td>> 120 mm^2</td><td>70 mm^2</td></tr>
</table>

2.3.3 Metal parts of portable appliances are to be earthed, where required (see [2.1.1]), by means of an earth-continuity conductor in the flexible supply cable or cord, which has the cross-sectional area specified in Tab 1 and which is earthed, for example, through the associated plug and socket.

2.3.4 In no circumstances is the lead sheathing or armour of cables to be relied upon as the sole means of earthing.

2.4 Connection to the structure

2.4.1 In case of yachts with metallic construction every connection of an earth-continuity conductor or earthing lead to the yacht's structure is to be secured by means of a screw of brass or other corrosion-resistant material of diameter not less than 6 mm.

2.4.2 Such earthing connection is not to be used for other purposes.

2.4.3 The connection described in [2.4.1] is to be located in an accessible position where it may readily be checked.

2.4.4 In case of yacht of non metallic construction, where earthing connection is provided, a conductor is to be provided with the function of collector connected to a specific earthing plate. The earthing plate is to be a plate, free

from paint, having a thickness of at least 2 mm and a surface area not less than 0,25 m2, fixed to the hull below the lowest waterline so as to remain fully submerged in any listing or heeling condition. The earthing plate is to be made of copper or other conductive material, compatible with sea water and having a surface area such as to give a resistance equivalent to that of a copper earthing connection. The formation of electrochemical couples with other immersed metallic materials is to be avoided which could cause electrolytic corrosion..

2.5 Earthed distribution systems

2.5.1 The system earthing of earthed distribution systems is to be effected by means independent of any earthing arrangements of non-current carrying parts and is to be connected to the hull at one point only.

2.5.2 In an earthed distribution system in which the earthing connection does not normally carry current, this connection is to conform with the requirements of [2.3], except that the lower limit of 70 mm^2 (see Tab 1) does not apply.

2.5.3 In a distribution system with hull return, the system earthing connection is to have at least the same cross-sectional area as the feeder lines.

2.5.4 The earthing connection is to be in an accessible position where it may readily be inspected and disconnected for insulation testing.

2.6 Aluminium superstructures

2.6.1 When aluminium superstructures are insulated from the steel hull to prevent electrolytic corrosion, they are to be secured to the hull by means of a separate bonding connection.

2.6.2 The connections are to be adequately close together and are to have a resistance less than 0.1 Ω.

2.6.3 The connections are to be located where they may readily be inspected.

3 Vented type storage batteries

3.1 General

3.1.1 Batteries are to be arranged so that each cell or crate of cells is accessible from the top and at least one side to permit replacement and periodical maintenance.

3.1.2 Cells or crates are to be carried on insulating supports of material non-absorbent to the electrolyte (e.g. treated wood).

3.1.3 Cells are to be securely chocked by means of insulating material non-absorbent to the electrolyte, e.g. strips of treated wood. Special mechanical precautions are to be taken to prevent the emergency battery fron being damaged by the shock due to a collision.

3.1.4 Provision is to be made for the free circulation of air.

3.2 Protection against corrosion

3.2.1 The interior of battery compartments (rooms, lockers, boxes) including all metal parts subject to the electrolyte is to be protected against the deteriorating effect of the latter by electrolyte-resistant coating or other equivalent means, unless corrosion-resistant materials are used.

3.2.2 Interior surfaces of metal shelves for battery cells, whether or not grouped in crates or trays, are to be protected by a lining of electrolyte-resistant material, watertight and carried up to at least 75 mm on all sides. In particular, linings are to have a minimum thickness of 1,5 mm, if of lead sheet for lead-acid batteries, and of 0,8 mm, if of steel for alkaline batteries.

Alternatively, the floor of the room or locker is to be lined as specified above to a height of at least 150 mm.

3.2.3 Battery boxes are to be lined in accordance with [5.2.2] to a height of at least 75 mm.

4 Switchgear and controlgear assemblies

4.1 Main switchboard

4.1.1 The main switchboard is to be so arranged as to give easy access as may be needed to apparatus and equipment, without danger to personnel.

4.1.2 If necessary, the clear height above the switchboard specified by the manufacturer is to be maintained for pressure relief in the event of a short-circuit.

4.1.3 When the voltage exceeds the safety voltage, non-conducting mats or gratings are to be provided at the front and rear of the switchboard as necessary.

4.1.4 Piping and conduits are not to be installed directly above or in the vicinity of switchboards and controlgear assemblies.

Where this is unavoidable, pipes and conduits are to have welded joints only or to be provided with protection against spray from steam or pressurised liquids or dripping.

4.2 Emergency switchboard

4.2.1 For the installation of the emergency switchboard, the same requirements apply as given in [4.1] for the installation of the main switchboard.

4.3 Distribution boards

4.3.1

For the installation of distribution boards, the same requirements apply, as far as applicable, as given in [4.1] for the installation of the main switchboard.

5 Cables

5.1 General

5.1.1 Cables having a protective covering which may damage the covering of more vulnerable cables are not to be bunched with the latter.

5.1.2 Cables having a bare metallic sheath (e.g. of copper) or braid or armour are to be installed in such a way that galvanic corrosion by contact with other metals is prevented.

5.1.3 All cables and wiring external to equipment are to be so installed as not to impair their original flame-retarding properties.

5.2 Radius of bend

5.2.1 The internal radius of bend for the installation of cables is to be chosen according to the type of cable as recommended by the manufacturer.

5.3 Fixing of cables

5.3.1 Cables shall be installed and supported in such a manner as to avoid chafing or other damage.

5.3.2 The supports (tray plates, separate support brackets or hanger ladders) and the corresponding accessories are to be of robust construction and of corrosion-resistant material or suitably treated before erection to resist corrosion.

When cables are installed directly on aluminium structures, fixing devices of aluminium or suitably treated steel are to be used.

For mineral-insulated cables with copper sheath, fixing devices in contact with the sheath are to be of copper alloy.

5.3.3 With the exception of cables installed in pipes, conduits, trunkings or special casings, cables are to be fixed by means of clips, saddles or straps of suitable material, in order to tighten the cables without their coverings being damaged.

5.3.4 Cable clips or straps made from a material other than metal are to be manufactured of a flame-retardant material.

5.3.5 The distances between fastenings and between supports are to be suitably chosen according to the type and number of cables and the probability of vibration.

5.3.6 When cables are fixed by means of clips or straps made from a material other than metal and these cables are not laid on top of horizontal cable supports (e.g. in the case of vertical installation), suitable metal clips or saddles spaced not more than 1 metre apart are to be used in addition in order to prevent the release of cables during a fire.

5.3.7 Suspended cables of fire-resisting type are to be fixed by means of steel straps spaced not more than 500 mm apart.

5.4 Mechanical protection

5.4.1 Cables exposed to risk of mechanical damage are to be protected by metal casing, profiles or grids or enclosed in metal pipes or conduits, unless the cable covering (e.g. armour or sheath) provides adequate mechanical protection.

5.4.2 In situations where there would be an exceptional risk of mechanical damage, e.g. in holds, storage spaces, etc., cables are to be protected by metal casing, trunkings or conduits, even when armoured, if the yacht's structure or attached parts do not afford sufficient protection for the cables.

5.4.3 For the protection of cables passing through decks, see [5.5.3].

5.4.4 Metal casing used for mechanical protection of cables is to be effectively protected against corrosion.

5.5 Penetrations of bulkheads and decks

5.5.1 If cables have to pass without adequate support through non-watertight bulkheads and generally through holes drilled in sheets of structural steel, these holes are to be fitted with glands or bushings of suitable material.

5.5.2 If cables have to pass through a watertight bulkhead or deck, the penetration is to be effected in a watertight manner.

Either suitable individual watertight glands for single cables or boxes containing several cables and filled with a flame-retardant packing may be used for this purpose.

Whichever type of penetration is used, the watertight integrity of the bulkheads or deck is to be maintained.

5.5.3 Cables passing through decks and continuing vertically are to be protected against mechanical damage to a suitable height above the deck.

5.5.4 Where cables pass through bulkheads or decks separating areas with a risk of explosion, arrangements are to be such that hazardous gas or dust cannot penetrate through openings for the passage of cables into other areas.

5.5.5 Where cables pass through a bulkhead or deck which is required to have some degree of fire integrity, penetration is to be so effected as to ensure that the required degree of fire integrity is not impaired.

5.6 Expansion joints

5.6.1 If there is reason to fear that a tray plate, pipe or conduit may break because of the motion of the yacht, different load conditions and temperature variations, appropriate expansion joints are to be provided.

This may apply in particular in the case of cable runs on the weather deck.

5.7 Cables in closed pipes or conduits

5.7.1 Closed pipes or conduits are to have such internal dimensions and radius of bend as will permit the easy drawing in and out of the cables which they are to contain; the internal radius of bend is to be not less than that permitted for cables and, for pipes exceeding 63 mm external diameter, not less than twice the external diameter of the pipe where this value is greater.

5.7.2 Closed pipes and conduits are to be suitably smooth on the interior and are to have their ends shaped or bushed in such a way as not to damage the cable covering.

5.7.3 The space factor (ratio of the sum of the cross-sectional areas corresponding to the external diameters of the cables to the internal cross-sectional areas of the pipe or conduit) is to be not greater than 0,4.

5.7.4 If necessary, openings are to be provided at the highest and lowest points so as to permit air circulation and ensure that the heat from the cables can be dissipated, and to obviate the possibility of water accumulating at any part of the pipe or conduit.

5.7.5 Vertical trunking for electrical cables is to be so constructed as not to jeopardise the required passive fire protection between the spaces.

5.7.6 Metal pipes or conduits are to be protected against corrosion.

5.7.7 Non-metallic pipes or conduits are to be flame-retardant.

5.8 Cables in casings or trunking and conduits with removable covers

5.8.1 Covers are to be removable and when they are open, cables are to be accessible.

5.8.2 Materials used are to comply with [5.7.6] and [5.7.7].

5.8.3 If the fixing of covers is by means of screws, the latter are to be of non-rusting material and arranged so as not to damage the cables.

5.8.4 Means are to be provided to ensure that the heat from the cables can be dissipated and water accumulation is avoided (see [5.7.4]).

5.9 Cable ends

5.9.1 Terminations in all conductors are to be so made as to retain the original electrical, mechanical, flame-retarding properties of the cable.

5.9.2 Where mechanical clamps are not used, the ends of all conductors having a cross-sectional area greater than 4 mm^2 are to be fitted with soldering sockets or compression-type sockets of sufficient size to contain all the strands of the conductor.

5.9.3 Cables not having a moisture-resistant insulation (e.g. mineral-insulated) are to have their ends effectively sealed against ingress of moisture.

5.10 Joints and tappings (branch circuit)

5.10.1 Cable runs are normally not to include joints. Where absolutely necessary, cable joints are to be carried out by a junction method with rebuilding of the insulation and protective coverings.

5.10.2 Joints in all conductors are to be so made as to retain the original electrical (continuity and isolation), mechanical (strength and protection), flame-retarding and, where necessary, fire-resisting properties of the cable.

5.10.3 Tappings (branch circuits) are to be made via suitable connections or in suitable boxes of such design that the conductors remain adequately insulated and protected from atmospheric action and are fitted with terminals or busbars of dimensions appropriate to the current rating.

5.10.4 Cables for safety voltages are not to terminate in the same connection boxes as cable for higher voltages unless separated by suitable means.

5.11 Earthing and continuity of metal coverings of cables

5.11.1 All metal coverings of cables are to be electrically connected to the metal hull of the yacht.

5.11.2 Metal coverings are generally to be earthed at both ends of the cable, except for [5.11.3] and [5.11.4].

5.11.3 Single-point earthing is admitted for final sub-circuits (at the supply end), except for those circuits located in areas with a risk of explosion.

5.11.4 Earthing is to be at one end only in those installations (mineral-insulated cables, intrinsically safe circuits, control circuits) where it is required for technical or safety reasons.

5.11.5 Metal coverings of single-core a.c. cables and special d.c. cables with high "ripple" content (e.g. for thyristor equipment) are to be earthed at one point only (e.g. at the mid-point).

5.11.6 The electrical continuity of all metal coverings of cables throughout the length of the latter, particularly at joints and tappings, is to be ensured.

5.11.7 The metal covering of cables may be earthed by means of glands intended for the purpose and so designed as to ensure an effective earth connection.

The glands are to be firmly attached to, and in effective electrical contact with, a metal structure earthed in accordance with these requirements.

5.11.8 The metal covering of cables may also be earthed by means of clamps or clips of corrosion-resistant material making effective contact with the covering and earthed metal.

5.12 Earthing and continuity of metal pipes, conduits and trunking or casings

5.12.1 Metal casings, pipes, conduits and trunking are to be effectively earthed.

5.12.2 Pipes or conduits may be earthed by being screwed into a metal enclosure, or by nuts on both sides of the wall of a metallic enclosure, provided the surfaces in contact are clean and free from rust, scale or paint and that the enclosure is in accordance with these requirements on earthing.

The connection is to be painted immediately after assembly in order to inhibit corrosion.

5.12.3 Pipes and conduits may be earthed by means of clamps or clips of corrosion-resistant metal making effective contact with the earthed metal.

5.12.4 Pipes, conduits or trunking together with connection boxes of metallic material are to be electrically continuous.

5.12.5 All joints in metal pipes and conduits used for earth continuity are to be soundly made and protected, where necessary, against corrosion.

5.12.6 Individual short lengths of pipes or conduits need not be earthed.

5.13 Precautions for single-core cables for a.c.

5.13.1 For the earthing of metal coverings see [5.11.5].

5.13.2 Where it is necessary to use single-core cables for alternating current circuits rated in excess of 20 A, the requirements of [5.13.3] to [5.13.7] are to be complied with.

5.13.3 Conductors belonging to the same circuit are to be contained within the same pipe, conduit or trunking, unless this is of non-magnetic material.

5.13.4 Cable clips are to include cables of all phases of a circuit unless the clips are of non-magnetic material.

5.13.5 In the installation of two, three or four single-core cables forming respectively single-phase circuits, three-phase circuits, or three-phase and neutral circuits, the cables are to be in contact with one another, as far as possible. In any event, the distance between the external covering of two adjacent cables is to be not greater than one diameter.

5.13.6 When single-core cables having a current rating greater than 250 A are installed near a steel bulkhead, the clearance between the cables and the bulkhead is to be at least 50 mm, unless the cables belonging to the same circuit are installed in trefoil twisted formation.

5.13.7 Magnetic material is not to be used between single-core cables of a group. Where cables pass through steel plates, all the conductors of the same circuit are to pass through a plate or gland, so made that there is no magnetic material between the cables, and the clearance between the cables and the magnetic material is to be no less than 75 mm, unless the cables belonging to the same circuit are installed in trefoil twisted formation.

5.14 Cables in refrigerated spaces

5.14.1 For the types of cables permitted in refrigerated spaces.

5.14.2 Power cables installed in refrigerated spaces are not to be covered by thermal insulation. Moreover, such cables are not to be placed directly on the face of the refrigerated space unless they have a thermoplastic or elastomeric extruded sheath.

5.14.3 Power cables entering a refrigerated space are to pass through the walls and thermal insulation at right angles, in tubes sealed at each end and protected against oxidation.

5.15 Cables in areas with a risk of explosion

5.15.1 Cables of intrinsically safe circuits are to be separated from the cables of all other circuits (minimum 50 mm).

5.16 Cables in the vicinity of radio equipment

5.16.1 All cables between antennas and transmitters are to be routed separately of any other cable.

5.16.2 Where it is necessary to use single-core cables, the arrangement of conductors is to be such as to avoid complete or partial loops.

6 Electrolytic corrosion

6.1 General

6.1.1 Metallic parts in contact with sea water, such as valves, pipes, engine casings, etc., not otherwise protected against electrolytic corrosion, are to be electrically connected to a copper conductor having the function of collector, connected in turn to sacrificial anodes.

SECTION 7 ELECTRIC PROPULSION PLANT

1 General

1.1 Applicable requirements

1.1.1 The following requirements apply to yachts for which the main propulsion plants are provided by at least one electric propulsion motor and its electrical supply. All electrical components of the propulsion plants are to comply with these requirements. As an alternative EN/ ISO 16315 may be applied.

1.2 Operating conditions

1.2.1 The normal torque available on the electric propulsion motors for manoeuvring is to be such as to enable the vessel to be stopped or reversed when sailing at its maximum service speed.

1.2.2 Adequate torque margin is to be provided for three-phase synchronous motors to avoid the motor pulling out of synchronism during rough weather and when turning.

1.2.3 When an electric generating plant has a continuous rating greater than the electric propulsion motor rating, means are to be provided to limit the continuous input to the motor. This value is not to exceed the continuous full load torque for which motor and shafts are designed.

1.2.4 The plant as a whole is to have sufficient overload capacity to provide the torque, power and reactive power needed during starting and manoeuvring conditions.

Locked rotor torque which may be required in relation to the operation of the vessel (e.g. for navigation in ice) is to be considered.

1.2.5 The electric motors and shaftline are to be constructed and installed so that, at any speed reached in service, all the moving components are suitably balanced.

2 Design of the propulsion plant

2.1 General

2.1.1 The electrical power for the propulsion system may be supplied from generating sets, dedicated to the propulsion system, or from a central power generation plant, which supplies the yacht's services and electric propulsion.

The minimum configuration of an electric propulsion plant consists of one prime mover, one generator and one electric motor. When the electrical production used for propulsion is independent of the board production, the diesel engines driving the electric generators are to be considered as main engines.

2.1.2 In electric propulsion plants having two or more constant voltage propulsion generating sets, the electrical power for the yacht's auxiliary services may be derived from this source.

2.2 Power supply

2.2.1 Where the plant is intended exclusively for electric propulsion, voltage variations and maximum voltage are to be maintained within the limits required in Sec 2.

2.2.2 In special conditions (e.g. during crash-stop manoeuvres), frequency variations may exceed the limits stipulated in Sec 2 provided that other equipment operating on the same network is not unduly affected.

2.2.3 The electric plant is to be so designed as to prevent the harmful effects of electromagnetic interference generated by semiconductor convertors.

2.2.4 The electric plant for the electrcial propulsion shall be designed to operate within the following harmonic distortion limits: a) single harmonic distortion < 3%, b) total harmonic distortion < 5% .

2.3 Auxiliary machinery

2.3.1 Propeller/thruster auxiliary plants are to be supplied directly from the main switchboard or from the main distribution board or from a distribution board reserved for such circuits, at the auxiliary rated voltage.

2.3.2 Propelling machinery installations with a forced lubrication system are to be provided with alarm devices which will operate in the event of oil pressure loss.

2.4 Electrical Protection

2.4.1 Automatic disconnections of electric propulsion plants which adversely affect the manoeuvrability of the yacht are to be restricted to faults liable to cause severe damage to the equipment.

2.4.2 The following protection of convertors is to be provided:

- protection against overvoltage in the supply systems to which convertors are connected
- protection against overcurrents in semiconductor elements during normal operation
- short-circuit protection.

2.4.3 Overcurrent protective devices in the main circuits are to be set sufficiently high so that there is no possibility of activation due to the overcurrents caused in the course of normal operation, e.g. during manoeuvring or in heavy seas.

2.4.4 Overcurrent protection may be replaced by automatic control systems ensuring that overcurrents do not reach values which may endanger the plant, e.g. by selective tripping or rapid reduction of the magnetic fluxes of the generators and motors.

3 Construction of rotating machines and semiconductor convertors

3.1 Ventilation

3.1.1 Where electrical machines are fitted with an integrated fan and are to be operated at speeds below the rated speed with full load torque, full load current, full load excitation or the like, the design temperature rise is not to be exceeded.

3.2 Protection against moisture and condensate

3.2.1 Machines and equipment which may be subject to the accumulation of moisture and condensate are to be provided with effective means of heating. The latter is to be provided for motors above 500 kW, in order to maintain the temperature inside the machine at about 3°C above the ambient temperature.

3.2.2 Provision is to be made to prevent the accumulation of bilge water, which is likely to enter inside the machine.

3.3 Rotating machines

3.3.1 Electrical machines are to be able to withstand the excess speed which may occur during operation of the yacht.

3.3.2 The design of rotating machines supplied by static convertors is to consider the effects of harmonics.

3.3.3 The winding insulation of electrical machines is to be capable of withstanding the overvoltage which may occur in manoeuvring conditions.

3.3.4 The design of a.c. machines is to be such that they can withstand without damage a sudden short-circuit at their terminals under rated operating conditions.

3.3.5 The obtainable current and voltage of exciters and their supply are to be suitable for the output required during manoeuvring and overcurrent conditions, including short-circuit in the transient period.

3.3.6 The electric rotating machines shall be in compliance with IEC 60034 series.

3.4 Semiconductor convertors

3.4.1 For parallel-connected convertor elements, an equal current distribution is to be ensured.

3.4.2 Means are to be provided, where necessary, to limit the effects of the rate of harmonics to the system and to other semiconductor convertors. Suitable filters are to be installed to keep the current and voltage within the limits given in Sec 2.

3.4.3 The semiconductor convertors shall be in compliance with IEC 60146.

4 Control and monitoring

4.1 General

4.1.1 The control and monitoring systems, including programmable electronic systems, are to be in accordance with EN/ ISO 16315 clause [5].

4.2 Indicating instruments

4.2.1 In addition to the provisions of [4.1], instruments indicating consumed power and power available for propulsion are to be provided at each propulsion remote control position.

4.2.2 The instruments specified in [4.2.3] and [4.2.4] in relation to the type of plant are to be provided on the power control board or in another appropriate position.

4.2.3 The following instruments are required for each propulsion alternator:

- an ammeter on each phase, or with a selector switch to all phases
- a voltmeter with a selector switch to all phases
- a wattmeter
- a tachometer or frequency meter
- a power factor meter or a var-meter or a field ammeter for each alternator operating in parallel
- a temperature indicator for direct reading of the temperature of the stator windings, for each alternator rated above 500 kW.

4.2.4 The following instruments are required for each a.c. propulsion motor:

- an ammeter on the main circuit
- an embedded sensor for direct reading of the temperature of the stator windings, for motors rated above 500 kW
- an ammeter on the excitation circuit for each synchronous motor
- a voltmeter for the measurement of the voltage between phases of each motor supplied through a semiconductor frequency convertor.

4.2.5 Where a speed measuring system is used for control and indication, the system is to be duplicated with separate sensor circuits and separate power supply.

4.2.6 An ammeter is to be provided on the supply circuit for each propulsion semiconductor bridge.

4.3 Alarm system

4.3.1 The control and monitoring systems, including programmable electronic systems, are to be in accordance with EN/ ISO 16315 clause [5].

4.3.2
Critical alarms for propulsion may be grouped, but are to be indicated to the bridge separately from other alarms.

4.4 Reduction of power

4.4.1 Power is to be automatically reduced in the following cases:

- low lubricating oil pressure of bearings of propulsion generators and motors
- high winding temperature of propulsion generators and motors
- fan failure in machines and convertors provided with forced ventilation, or failure of cooling system
- lack of coolant in machines and semiconductor convertors
- load limitation of generators or inadequate available power.

4.4.2 When power is reduced automatically, this is to be indicated at the propulsion control position (critical alarm).

4.4.3 Switching-off of the semiconductors in the event of abnormal service operation is to be provided in accordance with the manufacturer's specification.

5 Installation

5.1 Ventilation of spaces

5.1.1 Loss of ventilation to spaces with forced air cooling is not to cause loss of propulsion.

5.2 Cable runs

5.2.1 Where there is more than one propulsion motor, all cables for any one machine are to be run as far as is practicable away from the cables of other machines.

5.2.2 Cables which are connected to the sliprings of synchronous motors are to be suitably insulated for the voltage to which they are subjected during manoeuvring.

APPENDIX 1 BATTERY POWERED YACHTS

1 General

1.1 Application

1.1.1

The provisions of this Appendix apply to yachts where batteries, other than Lead and Nickel-Cadmium and Nickel-Metal-Hydride batteries, are installed to supply essential or not-essential services and emergency services, except batteries embedded in consumer products like computers and similar appliances, otherwise stated by Flag Administration.

1.1.2

The requirements in this Appendix are applicable to installations with a variety of lithium battery chemistry; since the battery technology is under development, additional requirements may be required by the Society on a case-by-case basis.

1.1.3

The Society may consider different arrangements than those stated in this Appendix, provided that they ensure an equivalent level of safety, to be demonstrated by appropriate risk analysis techniques.

1.2 Definitions

1.2.1

The following definitions and abbreviations are additional to those given in the other Parts of the Rules:

- Battery Management System (BMS): an electronic system that controls and monitors the state of the batteries by protecting the batteries from operating outside its safe operating area.
- Energy Management System (EMS): a system providing monitoring and control of the energy.
- Cell: an individual electrochemical unit of a battery consisting of electrodes, separators, electrolyte, container and terminals.
- Battery: assembly of cells ready for use as storage of electrical energy characterized by its voltage, size terminal arrangement, capacity and rate capability.
- Battery space: compartments (rooms, lockers or boxes) used primarily for accommodation of batteries .
- Battery system: the battery installation including battery banks, electrical interconnections, BMS and other safety features.
- Module: group of cells connected together either in a series and/or parallel configuration.
- State of Charge (SOC): state of charge expressed as a percentage of the rated capacity giving an indication of the energy available from the battery.
- State of Health (SOH): general condition of a battery, including its ability to deliver the specified performance compared with a new battery.
- Venting: release of excessive internal pressure from a cell/battery in a manner intended by design to preclude rupture or explosion.
- Explosion: failure that occurs when a cell container or battery case opens violently and major components are forcibly expelled.
- Fire: the emission of flames from a cell or battery.
- Upper limit of the charging voltage: the highest allowable charging voltage as specified by the cell Manufacturer.

1.3 Documentation to be submitted

1.3.1

In addition to the documents required in Sec 1, for battery powered yachts the plans and documents listed in Tab 1 are to be submitted.

The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the systems and components.

2 System design

2.1 General

2.1.1
Battery installations is regarded as generating set of the main source of electrical power on condition that the capacity of the battery installation is sufficient for the intended operation of the yacht and such design capacity is stated in the class certificate as an operational limitation.

2.1.2
In yachts or units where the main source of electrical power is based on battery installations only, the battery installation is to be divided into at least two independent battery systems located in two separate battery spaces, each having a capacity sufficient for the intended operation of the yacht.

Table 1 : Documentation to be submitted

No.	A/I **(1)**	Document
1	A	Block diagram and electrical wiring diagram of the battery system and system interfaced to the battery system, including control, monitoring and alarm system, emergency shutdown, PMS, etc.
2	I	Technical specification of the batteries, including technical data (electrical characteristics like voltage and capacity, discharge and recharge rates), battery chemistry and functional description of cell/battery system including at least cell/batteries configuration, safety devices (BMS), interfaces to monitoring/safety, diagnostic, including the list of controlled and monitored parameters.
3	I	Functional description of the energy management system (EMS), when required (see [2.1.3].
4	A	A risk assessment addressing all potential hazards represented by the type (chemistry) of batteries, the evaluation of the risk factors and measures to control and reduce the identified risks. Note: for the Risk Assessment reference is to be made to TASNEEF "Guide for Risk Analysis".
5	A	Test program Note: the test program is to include the functional tests as per [5.2] (alarm system, safety system, control system, etc.) [5] and further tests, if any, resulting from the Risk Assessment for the specific battery system.
6	A	Electrical load balance capable of reflecting the operational mode stated in the battery system operating philosophy (maximum designed deterioration rate is to be included).
7	A	A general arrangement plan of battery installation including the indication of structural fire protection and the safety systems **(2) (3)**.
8	I	Battery Manufacturer's instructions on active fire extinguishing system and confirmation about suitability of the proposed extinguishing agent for the specific type of batteries.
9	I	Statement of conformity of the batteries to IEC 62619, IEC 62620, IEC 60529 or UN38.3, when requested by the Rules.
10	I	Copy of type approval certificate of the battery systems, when requested by the Rules
11	I	An overall description of the battery system operating philosophy for each operational mode (including charging).
12	I	Operation and maintenance manuals including instructions for the safe connection/disconnection of batteries (see [5.4]).
13	A	Hazardous area classification (if applicable to the specific battery chemistry) and list of certified safety type electrical equipment installed in hazardous areas (as applicable).
14	I	Test Report of battery system at cellular, modular and system level in order to identify the damage potential of a possible thermal runaway event (Propagation Test) including gas analysis and explosion analysis as appli-cable and depending on the safety concept adopted.
15	I	Battery system maker statement confirming suitability of the selected fire extinguishing system and ventilation arrangement for the specific project.

(1) A: to be submitted for approval I: to be submitted for information

(2) Where a battery space is provided, based on the Risk Assessment (see [4.2]), evidence of the solution adopted for the battery space is to be given in the yacht's active (detection and fighting) and passive fire protection, gas detection system and ventilation system drawings.

(3) The plan has to show:

- the battery pack arrangement with respect to the space it is being installed in
- the clearance distances between the other ancillary equipment in the space and the battery pack.

2.1.3

When batteries are used as storage of power for the propulsion or dynamic positioning system or as part of the main source of electrical power, an Energy Management System (EMS) according to [3.5] is to be provided.

2.1.4

Where the batteries are used for propulsion and steering of the yacht, the system is to be so arranged that the electrical supply to equipment necessary for propulsion and steering will be maintained or immediately restored in the case of battery system failure.

2.1.5

Cables connecting each battery system to the main switchboard are to be arranged as per Sec 5.

2.1.6

A Risk Assessment, to be initiated in the design phase, is to be carried out to cover, but not limited to:

- evaluation of the risk factors,
- measures to control and reduce the identified risk, including potential gas development (e.g. toxic, corrosive), fire and explosion risk and
- action to be implemented.

The outcome of the assessment will give the additional measures to be adopted for minimizing the risks related to the use of batteries and among such measures, if the battery system needs to be installed in a space assigned to batteries only.

2.1.7

The risk assessment has:

- to identify risks due to external heating, fire or flooding
- to identify any fault in the battery system that may cause malfunction to essential services including but not limited to propulsion and steering or to emergency services and measures to mitigate the related risk,
- to evaluate any risk related to the location of batteries in the same spacewith other system supporting essential or emergency services, including pipes and electrical cables, distribution switchboards and so on, including but not limited to thermal runaway of the battery system, external and internal short-circuit,
- to evaluate any risk related to the location, in the same space, of batteries and other systems related to non essential services,
- to address sensor failures (e.g. temperature measurement sensor failure, individual cell voltage measurement sensor failure) and alarm, control and safety system failures (e.g. BMS and EMS failures including power and communication failures),
- to assess the selected fire extinguishing and ventilation arrangement according to battery system maker guidelines considering the specific design features of the yacht .

2.1.8

Battery cells of different physical characteristics, chemistries and electrical parameters are not to be used in the same electrical circuit.

2.1.9

The batteries are to be properly located (see [4]) and, where necessary, insulated to prevent overheating of the system.

2.1.10

The minimum required degree of protection is to be, in relation to place of installation of the battery system, according to Sec 3, [4]. Where water-based fire extinguishing system is used in the battery space, IP 44 is required as a minimum (see Note 1 and Note 2).

Note 1: if other fire-extinguish systems are used, the minimum IP can be reduced as result of the risk assessment.

Note 2: where the risk assessment identifies risks from water immersion (e.g. when batteries are installed below the freeboard deck), the batteries are to have a minimum degree of protection IP X7.

2.2 Constructional requirements

2.2.1

Battery enclosure covering modules and cells are to be made of flame retardant materials.

2.2.2

Each cell or battery case is to incorporate a pressure relief mechanism or is to be constructed in such a way to relieve excessive internal pressure at a value and rate that will be precluded rupture, explosion and self-ignition.

2.2.3

A thermal protection device, capable to disconnect the battery in case of high temperature, is to be provided in the battery.

2.2.4
The design and construction of battery modules have to reduce the risk of a thermal propagation due to a cell thermal runaway, maintaining it confined at the lowest possible level (e.g. confined within a module). This may be achieved by means of partition plates or sufficient distance in accordance with maker recommendation to prevent escalation between battery modules in case of a thermal runaway.

2.2.5
Terminals are to have clear polarity marking on the external surface of the battery. The size and shape of the terminal contacts are to ensure that they can carry the maximum cur- rent. External terminal contact surfaces are to be made of conductive materials with good mechanical strength and corrosion resistance. Terminal contacts are to be arranged so as to minimize the risk of short circuits.

2.2.6
The battery system is to be provided with a Battery Management System (BMS) according to [3.2].

2.3 Electrical protection

2.3.1
The outgoing circuits of the battery system are to be protected against overload and short-circuit by means of fuses or multi- pole circuit breakers having isolating capabilities.

2.3.2
An emergency shutdown system is to be installed and capable of disconnecting the battery system in an emergency.

2.3.3
The battery system is to have means for isolating purpose for maintenance purposes. This isolating device is to be independent of the emergency shutdown arrangement.

2.4 Battery charger

2.4.1
Battery chargers are to comply with the requirements of Sec 7.

2.4.2
The battery charger is to be designed to operate without exceeding the limits given by the battery system Manufacturer (e.g. current and voltage level).

2.4.3
The battery charger is to be interfaced with and controlled by the BMS.

2.4.4
Any detectable failure in the battery charger, including charging/discharging failure, is to give an alarm in a continuously manned control position.

3 Control, monitoring, alarm and safety systems

3.1 General

3.1.1
For the purpose of these Rules, unless differently state in the text, a required alarm is to be intended as an audible and visual alarm and is to be given in a continuously manned control position.

3.1.2
Control, monitoring, alarm and safety systems are to comply with the requirements of Chapter 3.

3.2 Battery management systems (BMS)

3.2.1
The BMS and related monitoring and safety systems (see [3.4]) are to have self-check facilities.
In the event of a failure, an alarm is to be activated.

3.2.2

The BMS is to be continuously powered so that a single failure of the power supply system does not cause any degradation of the BMS functionality; an alarm is to be given in the event of failure of any of the power supplies.

Unless the power supply is derived from different strings of batteries, one of the power supplies is to be derived from the emergency source of electrical power.

Where each battery is fitted with a BMS card, the individual cards may have a single power supply from the relevant battery.

An alarm is to be given and safety action taken in the event of loss of all the power supplies.

3.2.3

The battery management system (BMS) is to:

- provide limits for charging and discharging of the battery,
- protect against over-current, over-voltage and under-voltage by disconnection of the battery system,
- protect against over-temperature by disconnection of the battery system,
- provide cell and module balancing.

3.2.4

The following parameters are to be continuously monitored and indications are to be provided at a local control panel and in a continuously manned control position for:

- system voltage,
- max, min, average cell voltage,
- max, min and average cell or module temperature,
- battery string current.

3.2.5

When battery system is used as storage of power for the propulsion system or as part of the main source of electrical power, State of Charge (SOC) and State of Health (SOH) of the batteries are to be displayed at a continuously manned control station.

3.3 Alarm system

3.3.1

Abnormal conditions which can develop into safety hazards are to be alarmed before reaching the hazardous level.

3.3.2

Any abnormal condition in the battery system is to initiate an alarm.

3.3.3

At least the following conditions or events have to initiate an alarm at a local control panel and in a continuously manned control position:

- safety intervention of the BMS of the battery system,
- high ambient temperature,
- failure of cooling system or leakage of liquid cooling system,
- low ventilation flow inside the battery room,
- overvoltage and undervoltage,
- cell voltage unbalance,
- high cell temperature,
- other safety protection functions.

Other possible abnormal conditions are to be considered on the basis of the outcome of the Risk Assessment (see [2.1.7]) and relevant mitigating measures are to be adopted.

3.3.4

When batteries are used as storage of power for the propulsion or dynamic positioning systems or as part of the main source of electrical power, an alarm is to be given on the bridge when State of Charge (SOC) reaches minimum required capacity for yacht intended operations.

3.4 Safety system

3.4.1
The safety systems are to be:

- designed so as to limit the consequence of internal failures (e.g. failure in the safety system is not to cause shut down of battery system)
- self-monitoring,
- capable of acting on the controlled system following the fail-to safety principle,
- capable of detecting sensor malfunctions.

3.4.2
The safety systems are to be activated automatically in the event of identified conditions which could lead to damage of the battery system. Activation of any automatic safety actions is to activate an alarm. Manual override of safety functions is not to be possible.

3.4.3
Voltage of any one of the single cells is not to exceed the upper limit of the charging voltage as specified by the cell Manufacturer. The battery charger is to be stopped when the upper limit of the charging voltage is exceeded for any one of the single cells.

3.4.4
An emergency shutdown (ESD) system is to be arranged as a separated hardwired circuit and it is to be independent from the control system.

3.4.5
Activation means of the ESD are to be provided locally, from outside the battery space, and from a continuously manned control station.

3.4.6
When battery installation is used as storage of power for the propulsion or dynamic positioning systems or as part of the main source of electrical power, the emergency shutdown is also to be located on the bridge.

3.4.7
When battery installation is used as storage of power for the propulsion or DP systems or as part of the main source of electrical power, in case of over temperature in the battery system, an alarm and a request of manual load reduction is to be given on the bridge at a temperature lower than the one causing intervention of the BMS. As an alternative an automatic load reduction system may be provided. Its intervention is to generate an alarm.

3.4.8
Other possible abnormal conditions, which could lead to damage or additional hazards to battery system, are to be considered on the basis of the outcome of the Risk Assessment.

3.4.9
Sensors are to be designed to withstand the local environment.

3.4.10
The enclosure of the sensor and the cable entry are to be appropriate to the space in which they are located.

3.4.11
Cables to be operable under fire conditions (e.g. where required as result of the Risk Assessment), are to be of a fire-resistant type complying with IEC Publication 60331 series.

3.5 Energy Management system

3.5.1
When required per [2.1.3], an energy management system (EMS) is to be provided complying with the requirements of Chapter 3 consisting of several levels of controls and alarm functions, such as:

- monitoring and alarm functions of all power sources, inverters and disconnectors;
- voltage and power control for DC distribution system;
- available power and charge/discharge status of the storage energy source;

- interface with Power Management System (PMS) for combinations of AC and DC distribution systems;
- inverter control for the overall system.

The energy management system (EMS) is to be independent from the battery management system (BMS) for lithium batteries, however EMS may be integrated in the PMS.

The EMS is to be continuously supplied by uninterruptible power supply systems (UPS) and a failure is to initiate an alarm in a manned location.

3.5.2

The EMS is to be capable to provide at least the following information on the bridge:

- energy available from batteries (SOC),
- power available from batteries,
- time or range for which the battery can provide energy according to actual operational conditions,
- alarm for minimum capacity reached,
- battery state of health (SOH).

4 Location

4.1 General

4.1.1

Batteries are to be arranged aft of collision bulkhead and in such a way that danger to persons and damage to vessel due to failure of the batteries (e.g. caused by gassing, explosion, and fire) is minimized.

4.1.2

Batteries are not to be located in a battery box on the open deck exposed to sun and frost.

They are to be located where they are not exposed to excessive heat, extreme cold, spray, steam, shocks or vibration or other conditions which would impair their safety, performance or accelerate deterioration.

4.1.3

Batteries are to be located in such a way that the ambient temperature remains within the Manufacturer's specification at all times.

4.1.4

Batteries are to be suitably housed by means of compartments (rooms, lockers or boxes) which are to be properly constructed and efficiently ventilated and cooled (as necessary) in such a way to keep the battery system at a specified set of environmental conditions.Depending on installation Risk Assessment that shall be issued this requirement can be partially waived .

4.1.5

Battery system is to be arranged following the Manufacturer's prescriptions in particular to prevent cascade effects in case of a thermal runaway (e.g. partition plates or distance in accordance with Manufacturer's recommendations).

4.1.6

Batteries are to be located in a battery space placed outside the machinery space within the extreme borders of the main machinery space of Category A, spaces containing main or emergency source of electrical power, associated transforming equipment if any, or other high fire risk spaces containing stowed flammable liquid and preferably not adjacent to them. Exceptions will be evaluated on a Risk Assessment basis.

4.1.7

When the main source of electrical power is based on battery installations only, one of the two battery systems required in [2.1.2] is to be placed in a battery space located in the same machinery space of the main switchboard.

4.1.8

Depending on the battery chemistry, it may be necessary to define a hazardous area for the installation of appropriate equipment (see Tab 1 No. 6).

4.2 Battery space

4.2.1

When required, based on [4.1.4] or the Risk Assessment (see [2.1.6]), a space assigned to batteries only is to be foreseen.

4.2.2

Access to this space is to be through self-closing doors. As an alternative normally closed doors with alarm may be considered.

4.2.3

External hazards, such as fire and water ingress are to be taken into account in the Risk Assessment, in order to assess the risk associated with an external event (e.g. a fire spreading from adjacent rooms to the battery space, water flooding and so on) and possible countermeasures (e.g. suitable segregation of the battery space).

No heat sources or high fire risk equipment are to be located in battery spaces.

4.2.4

A fire detection system and a fixed fire extinguishing system appropriate to the battery chemistry are to be provided in the battery space.

The type is to be chosen following the battery Manufacturer's instructions.

Examples of fire extinguishing systems may be a powder or a gas based or water-based fixed fire extinguishing system provided that the suitability of the extinguishing agent for the specific type of batteries is confirmed by the battery Manufacturer.

Automatic release is only acceptable for small, not accessible, battery spaces.

Where an automatic release of fire extinguishing media is accepted, its activation is to be confirmed by more than one sensor.

4.2.5

The battery spaces are to be fitted with a forced ventilation system of extraction type, which is to be:

- independent from any other ventilation system serving other spaces,
- provided with local manual stop, still available in case of failure of the automatic and or remote control system,
- provided with indication of ventilation running and of battery space ambient temperature,
- with a capacity (rate) according to battery manufacturer guidelines on the basis of the gas release identified in the gas analysis or propagation test,
- fitted with inlet from open air,
- fitted with exhaust outlet to open air far from accommodation and machinery ventilation inlets,
- fitted with non-sparking fans driven by a certified safe type electric motor in case the ventilation duct is considered to contain ex-plosive atmosphere in case of thermal runaway.

4.2.6

Appropriate means to maintain the battery working temperature within the Manufacturer's declared limits are to be provided (e.g. by means of liquid cooled solutions or ventilation systems provided with control of air temperature).

4.2.7

Battery modules with liquid cooling are to be designed such that the risk of a cooling liquid leakage inside the module is minimized.

The cooling system is to include at least two pumps for each primary and secondary circuits: one main and one standby. The standby pump can be omitted only if the consequences of main pump failure are addressed in the risk assessment [2.1.7].

4.2.8

In case of liquid cooled solutions, a ventilation system is anyway required to extract possible gases or vapours in consequence of a battery abnormal condition.

4.2.9

Depending on the battery chemistry, a gas detection system, for the gases that may be emitted from the battery system in the event of a serious fault, may be requested as an outcome of the risk assessment.

In this case,

- an alarm at 30% of LEL and automatic disconnection of batteries are to be provided,
- an alarm at 60% of LEL and automatic disconnection of all electrical equipment non certified of safety type for the specific hazardous area, gas, vapour are to be provided.

A failure in the gas detection system is to be alarmed but is not to cause above mentioned automatic disconnections.

4.2.10
Depending on the battery chemistry, appropriate ventilation to prevent the formation of explosive atmospheres in the battery space (e.g. to limit the concentration of flammable gasses and thereby reduce the risk for fire) is to be provided.

At this purpose the highest rate of gas emissions is to be considered.

4.2.11
Depending on the battery chemistry, when a hazardous area is to be considered, mechanical exhaust non-sparking fan driven by a certified safe type electric motor, and inlet from open air are to be arranged.

4.2.12
Battery spaces are to be insulated in way of other spaces with at least B-15 class divisions.

4.2.13
Battery spaces are to be considered as spaces not normally manned.

4.2.14
The battery space is not to contain other systems supporting essential or emergency services, including piping and electric cables serving such systems, in order to prevent their loss upon possible failures (e.g. thermal runaway) in the battery system.

5 Testing

5.1 General

5.1.1
Battery systems are to be tested by the Manufacturer.

5.1.2
Batteries are to be subjected to functional and safety tests according to IEC Publication 62619 and 62620 , or UN 38.3 or in accordance with other equivalent national or international standards.

5.1.3
When the aggregate capacity of a battery system exceeds the rating of 20 kWh, the battery system is to be of a type approved in accordance with the Society "Rules for the type approval certification of lithium battery systems”.

Chapter 3
AUTOMATION

SECTION 1 GENERAL

1 General

1.1 General

1.1.1 TASNEEF Rules for the Classification of yachts (RES 31) Pt C, Ch 3 is to be applied. Alternatives and deviations from
what above may be agreed with the Society.

Chapter 4

FIRE PROTECTION, DETECTION AND EXTINCTION

SECTION 1 GENERAL REQUIREMENTS

1 Definitions

1.1 Application

1.1.1 This Chapter is applicable, in general, alternative arrangement may agreed with the Society.

1.2 Definitions

1.2.1 The definition used in this chapter are those contained in SOLAS and other IMO publications.

1.2.2 Battery charging station

A permanently (fixed) integrated element of the vessel electrical plant for the recharging of plug-in equipment. A fixed charging station provides electrical conversion, monitoring, or safety functionality. Standard electrical sockets or outlets are not to be considered fixed charging stations.

2 Documentation to be submitted

2.1

2.1.1 The Interested Party is to submit to the Society the documents listed in Tab 1.

Table 1 : Documentation to be submitted

No	I/A **(1)**	Document **(2)**
1	A	Structural fire protection, showing the method of construction and the purpose of the various spaces of the yacht
2	A	Natural and mechanical ventilation systems showing the penetrations of class divisions, location of dampers, means of closing, arrangements of air conditioning rooms
3	A	Means of escape
4	A	Automatic fire detection systems
5	A	Arrangement of fixed fire-extinguishing systems **(2)**
6	A	Electrical diagram of fixed fire-extinguishing system for engine room
7	A	Electrical diagram of power control and position indication circuits for fire doors if any
8	I	General arrangement plan

(1) A: to be submitted for approval i
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
- materials and dimensions of piping and associated fittings
- volumes of protected spaces, for gas fire-extinguishing systems
- capacity, in volume and/or in mass, of vessels or bottles containing the extinguishing media for gas 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.

3 Type Approved Products

3.1

3.1.1 In general materials, equipment or products to be used for fire protection are to be type approved by the Society. In special cases the Society may accept a Type Approval Certificate issued by another recognised organisation, or, for individual yachts, the Society may consider acceptance on the basis of ad hoc tests.

SECTION 2 FIRE PREVENTION

1 Engine space arrangement

1.1

1.1.1 The boundary of the engine space is to be arranged in order to contain the fire-extinguishing medium so that it cannot escape.

1.1.2 Combustible materials and flammable liquid excluding fuel oil necessary for the propulsion engines are not to be stowed in the engine space.

1.1.3 Machinery spaces of category A and engine spaces are to be ventilated to prevent the build-up of explosive gases.

1.1.4 In order to contain the oil, it may be acceptable to fit a drip tray in way of the engine. The use of the engine bearers as a means of containment of the oil may be accepted provided that they are of sufficient height and have no limber holes.

Efficient means are to be provided to ensure that all residues of persistent oils are collected and retained on board for discharge to collection facilities ashore.

1.1.5 Means are to be adopted for the storage, distribution and utilisation of fuel oil in order to minimise the risk of fire.

1.1.6 Fuel oil, lubricating oil and other flammable liquids are not to be stored in fore peak tanks.

1.1.7 Fuel oil tanks situated within, or adjacent to, the boundaries of category A machinery spaces are not to contain fuel oil having a flashpoint of less than 60ºC.

1.1.8 Every fuel oil pipe which, if damaged, would allow oil to escape from a storage, settling or daily service tank situated above the double bottom is to be fitted with a cock or valve directly on the tank. Such cock or valve is to be capable of being closed locally and from a safe position outside the space in which such tanks are fitted in the event of fire occurring in the space.

1.1.9 Means are to be provided to stop fuel transfer pumps, fans and separators from outside the machinery space.

2 Liquid petroleum gas for domestic purposes

2.1

2.1.1 Where gaseous fuel is used for domestic purposes, the arrangements for the storage, distribution and utilisation of the fuel is to be such that, having regard to the hazards of fire and explosion which the use of such fuel may entail, the safety of the yacht and the persons on board is preserved. The installation is to be in accordance with App 1 or other recognised national or international standards.

Hydrocarbon gas detectors and carbon monoxide detectors are to be provided.

2.1.2 Open flame gas appliances fitted on board for cooking, heating or any other purpose are to be in compliance with recognised international standards.

2.1.3 Materials which are fitted close to open flame cooking and heating appliances are to be non-combustible, except that the exposed surfaces of these materials are to be protected with a finish having a class 1 surface spread of flame rating when tested in accordance with ASTM D 635.

Where combustible materials or other materials which do not have a class 1 surface spread of flame rating are fitted, they are not to be placed unprotected within the following distances of a standard cooker:

a) 400 mm vertically above the cooker, for horizontal surfaces, when the vessel is upright;

b) 125 mm horizontally from the cooker, for vertical surfaces.

2.1.4 Curtains or any other suspended textile materials are not to be fitted within 600 mm of any open flame cooking, heating or other appliance.

2.1.5 After the completion of the installation on board, the system is to be checked at operating pressure by means of a pneumatic test.

When all leakage has been repaired, all appliance valves are to be closed and the cylinder shut-off valve opened.

When the gauge registers that the system is pressurised, the cylinder valve is to be closed.

It is to be verified that the pressure reading value remains constant for at least 15 minutes.

2.1.6 An open flame gas appliance provided for cooking, heating or any other purpose is to comply with the requirements of EC Directive 90/396/EEC or equivalent.

2.1.7 Compartments for gas cylinders are to be fitted with:

- effective natural ventilation, and
- doors that open outwards and are directly accessible from the open deck, and
- bulkhead doors and other means of closing any openings gas-tight to the vessel's interior, separating such compartments from adjoining spaces.

3 Space heaters

3.1 General requirements

3.1.1 Space heaters, if used, are to be fixed in position and so constructed as to reduce fire risks to a minimum. The design and location of these units is to be such that clothing, curtains or other similar materials cannot be scorched or set on fire by heat from the unit.

4 Materials

4.1

4.1.1 Except in refrigerated compartments of service spaces, all insulation (e.g. fire and comfort) is to be of non-combustible or at least not readily ignitable. Not readily ignitiable means that the material stops to burn within 20 seconds when tested in accordance with para 4.1.1 and 4.1.2 MSC/Circ. 1006

4.1.2 In spaces where penetration of oil products is possible, the surface of insulation is to be impervious to oil or oil vapours. Insulation boundaries are to be arranged to avoid immersion in oil spillages.

4.1.3 Paints, varnishes and other surface finishes to be used in machinery spaces, galleys and spaces with fire risk as far as practicable are not to be capable of producing excessive quantities of smoke or toxic products when they burn, this being determined in accordance with the Fire Test Procedures Code or an alternative national or international standard.

5 Batteries charging station

5.1

5.1.1 Batteries charging: movable/Portable batteries, of a type other than Lead and Nickel-Cadmium batteries (including batteries fitted on onboard equipment, toys, appliances etc.), during the charging process shall be placed in a well ventilated area onboard which is either an open deck, or in a continuously manned area or an area which is covered by a gas, smoke and heat detection system and an automatic fixed fire extinguishing system.

In all other cases the relevant requirements of Pt C, Ch 2, App 1 will be applied on a risk assessment base.

SECTION 3 FIRE DETECTION

1 General

1.1

1.1.1 The purpose of this Section is to detect a fire in the space of origin and to provide for an alarm for safe escape and fire-fighting activity.

2 Fixed fire detection and fire alarm systems

2.1 General

2.1.1 A fixed fire detection and fire alarm system is to be fitted in all enclosed spaces except those containing no significant fire risk (toilets, bathrooms, void spaces, etc).

The system is to meet the following functional requirements:

- fixed fire detection and fire alarm system installations are to be suitable for the nature of the space, fire growth potential and potential generation of smoke and gases; and
- manually operated call points are to be placed effectively to ensure a readily accessible means of notification.

The fixed fire detection and fire alarm system is to be installed in accordance with the requirements of SOLAS II- 2/7 and the IMO Fire Safety Systems Code, Chapter 9.

2.1.2 In addition to the requirements mentioned in SOLAS regulation II-2/7 and Chapter 9 of the IMO Fire Safety Systems Code, the main (respective emergency) feeder of the fire detector and alarm system is to run from the main (respective emergency) switchboard to the change-over switch without passing through any other distributing switchboard.

SECTION 4 FIRE CONTAINMENT

1 Structure

1.1 General

1.1.1 The purpose of these provisions is to contain a fire in the space of origin.

For this purpose, the following functional requirements are to be met:

- the yacht is to be subdivided by thermal and structural boundaries as required by these Rules
- thermal insulation of boundaries is to have due regard to the fire risk of the space and adjacent spaces
- the fire integrity of the division is to be maintained at openings and penetrations.

2 Forms of construction - fire divisions

2.1 General

2.1.1 When fire divisions are required in compliance with these Rules, they are to be constructed in accordance with the following requirements.

2.1.2 Fire divisions using steel equivalent, or alternative forms of construction, may be accepted if it can be demonstrated that the material by itself, or due to non-combustible insulation provided, has fire resistance properties equivalent to those divisions required by these Rules.

2.1.3 Insulation is to be such that the temperature of the structural core does not rise above the point at which the structure would begin to lose its strength at any time during the applicable exposure to the standard fire test. For B class divisions, the applicable exposure is 30 minutes.

2.1.4 For aluminium alloy structures, the insulation is to be such that the temperature of the structural core does not rise more than 200ºC above the ambient temperature at any time during the applicable fire exposure.

2.1.5 For composite structures, the insulation is to be such that the temperature of the laminate does not rise more than the minimum temperature of deflection under load of the resin at any time during the applicable fire exposure. The temperature of deflection under load is to be determined in accordance with a recognised international standard.

2.1.6 Insulation need only be applied on the side that is exposed to the greater fire risk; inside the engine room/box, a division between two such spaces is, however, to be insulated on both sides unless it is a steel division.

2.1.7 Special attention is to be given to the fixing of fire door frames in bulkheads constructed of materials other than steel. Measures are to be taken to ensure that the temperature of the fixings when exposed to fire does not exceed the temperature at which the bulkhead itself loses strength.

2.2 Equivalent fire division accepted without the exposure to the standard fire test

2.2.1 When fire divisions are required according to these Rules, the following may be accepted without the fire test.

Table 1

Type of material	B15 Class Division
Composite material	• two 25 mm layers of non-combustible high density mineral wool suitably alternated. The mineral wool is to have a minimum volumetric mass of 100 kg/m3. The outer surface of the mineral wool is to be suitably protected against any splashing from fuel oil or other flammable liquid, or • reinforced plastic of thickness not less than 13 mm with a final layer of self-extinguishing laminates (for a thickness not less than 1,5 mm)
Aluminium alloy plate	5,5 mm aluminium alloy plate thickness insulated with 80 mm of non-combustible high density mineral wool. The mineral wool is to have a minimum volumetric mass of 100 kg/m3. The outer surface of the mineral wool is to be suitably protected against any splashing from fuel oil or other flammable liquid.

3 Class divisions

3.1 Class divisions

3.1.1 Machinery spaces are to be reasonably gas tight and separated from accommodation spaces, service spaces, control stations, stairways and corridors by B-15 class divisions unless they division is made of steel.

3.1.2 For structures in contact with sea water, the required insulation is to extend to at least 300 mm below the lightest waterline.

3.1.3 Openings (doors, ventilation ducts, and similar items...) in B class divisions are to be provided with permanently attached means of closing that are to be at least as effective for resisting fires as the divisions in which they are fitted. Generally, windows are not to be fitted in machinery space boundaries.

3.1.4 Where B class divisions are penetrated for the passage of electrical cables, pipes, trunks, ducts, etc, or for girders, beams or other structural members, arrangements are to be made to ensure that the fire resistance is not impaired.

3.2 Openings in B class divisions

3.2.1 Doors and door frames and hatches in B class divisions and means of securing them are to provide a method of closure which has resistance to fire as far as practical equivalent to that of the divisions, except that a ventilation opening may be permitted in the lower portion of such doors.

3.2.2 Where B class divisions are penetrated for the passage of electrical cables, pipes, trunks, ducts, etc, or for the fitting of ventilation terminals, lighting fixtures and similar devices, arrangements are to be made to ensure that the fire resistance is not impaired.

3.3 Windows and portlights

3.3.1 All windows and portlights in bulkheads within accommodation spaces, service spaces and control stations are to be so constructed as to preserve the integrity requirements of the type of bulkheads in which they are fitted.

3.4 Details of construction

3.4.1 Without impairing the efficiency of the fire protection, the construction of ceilings and bulkheads is to allow a fire patrol to detect any smoke originating in concealed and inaccessible places, except where there is no risk of fire originating in such places.

3.4.2 When gaseous fuel is used for domestic purposes, the arrangements for the storage, distribution and utilisation of the fuel are to be such that, having regard to the hazards of fire and explosion which the use of such fuel may entail, the safety of the vessel and the persons on board are preserved.

In particular, open flame gas appliances provided for cooking, heating or any other purposes are to comply with the requirements of EC directive 90/396/EEC or equivalent and the installation of open flame gas appliances is to comply with the appropriate provisions of Section 2, [2.1].

4 Ventilating systems

4.1 General

4.1.1 Ventilation fans for machinery spaces and enclosed galleys are to be capable of being stopped and main inlets and outlets of the ventilation system closed from outside the spaces being served. This position is not to be readily cut off in the event of a fire in the spaces served.

4.1.2 Ventilation ducts serving machinery spaces, galleys, or high risk spaces are not to cross accommodation spaces, service spaces or control stations unless the trunking is constructed of steel (minimum thickness 4mm). The ducting within the accommodation is to be fitted with fire insulation to B class to a point at least 5m from the machinery space or galley.

4.1.3 Where the trunking passes from the machinery space or galley into the accommodation, automatic fire dampers are to be provided in the deck or bulkhead within the accommodation. The automatic fire dampers are also to be manually operable from outside the machinery space or galley.

4.1.4 Ventilation systems serving category A machinery spaces are to be independent of systems serving other spaces.

4.1.5 Adequate means of ventilation are to be provided to prevent the accumulation of dangerous concentrations of flammable gas which may be emitted from batteries.

4.1.6 All inlet and outlet ducts are to be provided with adequate weathertight means of closure operable from a readily accessible position.

SECTION 5 MEANS OF ESCAPE

1 General

1.1

1.1.1 The purpose of this Section is to provide means of escape so that persons on board can safely and swiftly escape to the liferaft embarkation deck. For this purpose, the following functional requirements are to be met:

- safe escape routes are to be provided
- escape routes are to be maintained in a safe condition, clear of obstacles; and
- additional aids for escape are to be provided as necessary to ensure accessibility, clear marking and adequate design for emergency situations.

1.2 General requirements

1.2.1 Stairways, ladders and corridors serving all spaces normally accessible are to be arranged so as to provide ready means of escape to a deck from which embarkation into survival craft may be effected. The arrangement of the vessel is to be such that all compartments are provided with a satisfactory means of escape.

2 Means of escape from accommodation

2.1 General

2.1.1 Means of escape are to be provided so that persons onboard can safely and swiftly escape to the liferaft embarkation deck. For the accommodation, two means of escape from every restricted space or group of spaces are to be provided.

2.1.2 The normal means of access to the accommodation and service spaces below the open deck is to be arranged so that it is possible to reach the open deck without passing through a galley, engine room or other space with a high fire risk, wherever practicable.

2.1.3 Where accommodation arrangements are such that access to compartments is through another compartment, the second escape route is to be as remote as possible from the main escape route. This may be through hatches of adequate size leading to the open deck or separate space to the main escape route.

2.1.4 The two means of escape are to be arranged in such a way that a single hazardous event will not cut off both escape routes.

2.1.5 Exceptionally one of the means of escape may be dispensed with, due regard being paid to the nature and location and dimension of spaces and to the number of persons who might normally be accommodated or employed there where in any position the person inside is not more than 5 metres from the exit or for the spaces that may be visited only occasionally In addition efficient fire detectors are to be provided as necessary to give early warning of a fire emergency which could cut off that single means of escape. The escape route is not to pass through a space with fire risk such as a machinery space, galley or space containing flammable liquids

3 Means of escape from machinery spaces

3.1 General

3.1.1 Means of escape from machinery spaces

Machinery spaces are to be provided with a minimum of one means of escape for unmanned spaces during normal operation and where the single access gives ready escape, at all times, in the event of fire. In other cases at least 2 means of escape have to be foreseen.

3.1.2 Means of escape from other spaces

As a general rule two means of escape have to be provided.

In exceptional circumstances a single means of escape may be accepted for spaces, other than accommodation spaces, that are entered only occasionally, if the escape route does not pass through a galley, machinery space or watertight door.

4 Escape route arrangement

4.1

4.1.1 Concealed escapes and escape routes are to be clearly marked to ensure ready exit and clearly identified with appropriate indications. No escape routes are to be obstructed by furniture or fittings.

Additionally, furniture along escape routes is to be secured in place to prevent shifting if the yacht rolls or lists.

All doors and hatches in escape routes are to be openable from either side. In both the direction they are all to be openable without a key or other tools.

All handles on the inside of weathertight doors and hatches are to be non-removable.

Where doors are lockable, measures to ensure access from outside the space are to be provided for rescue purposes.

4.1.2 Interior stairways, ladders, footholds and other means are to be permanently attached to grant safe escape at all times. The vertical distance from the higher step and the exit is not to be greater than 1,2m.

4.1.3 Multihulls are to be fitted with an emergency escape hatch in each main inhabited watertight compartment to permit the exit of personnel in the event of an inversion.

4.1.4 One of the exits may be an emergency exit through a small hatchway or through a porthole of dimensions generally not less than 450x450 mm. Other dimensions may be evaluated provided that the minimum dimension is not less than 380mm.

SECTION 6 FIRE APPLICATIONS

1 Fire applications

1.1 General requirements

1.1.1 Fire appliances are to be in conformity with Tab 1 and with the requirements of this Section.

The stowage position of fire appliances is to be clearly marked.

1.1.2 The capacity and quantity of the medium are to be in compliance with Tab 2.

Table 1 : Fire appliances

Num	Appliances	Number and specifications
1	Portable fire extinguishers	At least one portable fire extinguisher is to be fitted for each deck. The type of medium and quantity are to comply with the following items.
2	Fire extinguishers in machinery space	a) a fixed fire-extinguishing system in conformity with the requirements of item [2] b) one portable fire extinguisher type D-II;
3	Fire extinguishers and appliances in other service spaces	**Radio room/ space or wheelhouse:** 1 portable fire extinguisher type F-II near radio equipment or electrical apparatus; **Galley/Food preparation space:** 1 portable fire extinguisher type E-II fitted;
10	Fire extinguisher in sleeping accommodation	1 portable fire extinguisher type E-II for each accommodation space occupied by 4 persons or more and 1 portable fire extinguisher type E-I for each accommodation space occupied by less than 4 persons close to the entrance.

Table 2 : Type and medium capacity

Type	Foam (litres)	Carbon dioxide (kg)	Dry chemical powder (kg)
D-II	9	-	-
E-II	9	5	4
F-II	-	5	4
E-I	6	2	1

2 Fixed fire-extinguishing system

2.1

2.1.1 A fixed fire-extinguishing system is to be provided in machinery spaces.

2.1.2

The system is to be in compliance with the IMO FSS CODE and with the requirements given in Annex 2 of TASNEEF Rules fore the Classification of Yachts (RES 31) if carbon dioxide is used as fire extinguishing medium. Systems using other extinguishing medium (e.g. FM200, Novec 1230) may be accepted if certified in accordance with IMO requirements.

2.1.3

When the restricted dimensions of the machinery space do not allow a person to enter such space the fixed fire extinguishing system may be replaced by a portable fire extinguishing system suitably sized and a fire port in the machinery space enclosure.

APPENDIX 1 OPEN FLAME GAS INSTALLATIONS

1 General information

1.1 General

1.1.1 Possible dangers arising from the use of liquid petroleum gas (LPG) open flame appliances in the marine environment include fire, explosion and asphyxiation, due to leakage of gas from the installation.

1.1.2 Consequently, the siting of gas-consuming appliances and storage containers and the provision of adequate ventilation to spaces containing them are most important.

1.1.3 It is dangerous to sleep in spaces where gas-consuming open flame appliances are left burning, because of the risk of carbon monoxide poisoning.

1.1.4 LPG is heavier than air and, if released, may travel some distance whilst seeking the lowest part of a space. Therefore, it is possible for gas to accumulate in relatively inaccessible areas, such as bilges, and diffuse to form an explosive mixture with air, as in the case of petrol vapour.

1.1.5 A frequent cause of accidents involving LPG installations is the use of unsuitable fittings and improvised 'temporary' repairs.

2 Stowage of gas containers

2.1 General

2.1.1 LPG cylinders, regulators and safety devices are to be stowed on the open deck (where leakage will not accumulate) or in a compartment above the design water level when the vessel is heeled up to 30° protected from bad weather and solar radiation that is vapour-tight to the vessel’s interior, and fitted with a vent and drain, so that any gas which may leak can disperse overboard.

2.1.2 The vent and drain are to be not less 19 mm in diameter, run to the outside of the craft and terminate 75 mm or more above the 'at rest' waterline. Generally, the drain and locker ventilation is to be 500 mm or more from any opening to the interior.

2.1.3 The cylinders and associated fittings are to be positively secured against movement and protected from damage in any foreseeable event.

2.1.4 Any electrical equipment located in cylinder lockers is to be certified safe for use in the potentially explosive atmosphere in accordance with EN/ISO 8846.

3 Cylinders and attachments

3.1 General

3.1.1 Each system is to be fitted with a readily accessible, manually operated isolating valve in the supply pressure part of the system.

3.1.2 In multiple container installations, a non-return valve is to be placed in the supply line near to the stop valve on each container. If a change-over device is used (automatic or manual), it is to be provided with non-return valves to isolate any depleted container.

3.1.3 Where more than one container can supply a system, the system is not to be used with a container removed unless the unattached pipe is fitted with a suitable gas-tight plug arrangement.

3.1.4 Containers not in use or not being fitted into an installation are to have the protecting cap in place over the container valve.

4 Fittings and pipework

4.1

4.1.1

For rigid pipework systems, solid drawn copper alloy or stainless steel tubes are to be used. Steel tubing or aluminium or any materials having a low melting point are not to be used.

4.1.2 Connection between rigid pipe sections is to be made with hard solder (minimum melting point 450ºC). Appropriate compression or screwed fittings are recommended for general use for pipework in LPG installations.

4.1.3 Lengths of flexible piping (if required for flexible connections) are to conform to an appropriate standard, be kept as short as possible, and be protected from inadvertent damage. Such hose is to be installed in such a manner as to give access for inspection along its length.

Proposals for a more extensive use of flexible piping (which conforms to an internationally recognised standard for its application) are to be submitted to the Administration for approval on an individual basis.

5 Appliances

5.1 General

5.1.1 All appliances are to be well secured to avoid movement.

5.1.2 All unattended appliances are to be of the room sealed type, i.e where the gas flames are isolated in a totally enclosed shield where the air supply and combustion gas outlets are piped to open air.

5.1.3 All gas burners and pilot flames are to be fitted with a flame supervision device which will shut off the gas supply to the burner or pilot flame in the event of flame failure.

5.1.4 Flue-less heaters are to be selected only if fitted with atmosphere-sensitive cut-off devices to shut off the gas supply at a carbon dioxide concentration of not more than 1,5% by volume.

5.1.5 Heaters of a catalytic type are not to be used.

6 Ventilation

6.1 General

6.1.1 The ventilation requirements of a space containing an LPG appliance are to be assessed against an appropriate standard and are to take into account gas burning equipment and persons occupying that space.

6.1.2 Where ventilators required for the LPG appliances in intermittent use can be closed, there are to be appropriate signs at the appliance warning of the need to have those ventilators open before the appliance is used.

7 Gas detection

7.1 General

7.1.1 Suitable means for detecting the leakage of gas are to be provided in any compartment containing a gas-consuming appliance, or in any adjoining space of a compartment into which the gas (more dense than air) may seep.

7.1.2 Gas detector heads are to be securely fixed in the lower part of the compartment in the vicinity of the gas-consuming appliance and in other space(s) into which gas may seep. In areas where the detector head is susceptible to damage in the lowest part of the compartment (e.g. engine space bilge), such head is at least to be fitted below the lowest point of ignition.

7.1.3 Any gas detector is preferably to be of a type which will be actuated promptly and automatically by the presence of a gas concentration in air of not greater than 0,5% (representing approximately 25% of the lower explosive limit). The detection system is to incorporate a visible alarm and an audible alarm which can be heard in the space concerned and in the control position with the vessel in operation.

7.1.4 Where electrical detection equipment is fitted, it is to be certified as being flameproof or intrinsically safe for the gas being used.

7.1.5 In all cases, the arrangements are to be such that the detection system can be tested frequently while the vessel is in service; this is to include a test of the detector head operation as well as the alarm circuit, in accordance with the Manufacturers' instructions.

7.1.6 All detection equipment is to be maintained in accordance with the Manufacturers' requirements.

8 Emergency action

8.1 General

8.1.1 A suitable notice, detailing the action to be taken when an alarm is given by the gas detection system, is to be displayed prominently in the vessel.

8.1.2 The information given is to include the following:

a) The need to be ever alert for gas leakage; and

b) When leakage is detected or suspected, all gas-consuming appliances are to be shut off at the main supply from the container(s) and NO SMOKING is to be permitted until it is safe to do so.

c) NAKED LIGHTS are NEVER to BE USED AS A MEANS OF LOCATING GAS LEAKS.