

**PART II RULES FOR THE CONSTRUCTION
AND CLASSIFICATION OF VESSELS
IDENTIFIED BY THEIR MISSIONS**

TITLE 25 HIGH SPEED CRAFT

SECTION 7 ELECTRICITY

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CHAPTER A APPROACH

CHAPTER CONTENTS

A1. APPLICATION

A2. DEFINITIONS

A1. INCORPORATION OF THE INTERNATIONAL CODE OF SAFETY FOR HIGH SPEED VESSELS BY THE RBNA RULES

100. Incorporation of the Code

101. The present Part II, Title 25 of the Rules incorporate the International Code of Safety of High Speed Vessels in its entirety.

102. The original terminology of the Code has been maintained.

103. Under the conditions of A1.101 and A1.102 above and in those provisions of the HSC Code that are being used for classification purposes the words "Administration" and "Code", wherever mentioned, are to be understood as equivalent to the words "Society" and "Rules", respectively. The RBNA "Rules for the Construction and Classification of Ships destined to Open Sea Navigation" are referred to below simply as "Society Rules".

104. Equipment and arrangements dealt with in the parts of the Code such as those concerning life-saving appliances, radio communications and operational aspects, which are not subject to control by the Society, have been maintained to keep the integrity of the Code, and are to be covered by the relevant certification.

105. All the original texts from the code have been identified by a vertical line on the right side of the text, as demonstrated here.

106. Additional requirements and comments are inserted at the relevant Part of the Code are identified by the words "RBNA comment" before the text.

A2. APPLICATION

100. Application

101. The present Section 7 of Part II, Title 25, contains additional requirements to those of Part II, Title 11, Section 7 and applies to:

- a. passenger craft which do not proceed in the course of their voyage more than four hours at operational speed from a place of refuge; and

- b. cargo craft of 500 gross tonnage and upwards which do not proceed in the course of their voyage more than 8 h at operational speed from a place of refuge when fully laden.

102. RBNA comment: In addition these Rules also apply as far as appropriate to cargo craft of less than 500 tons gross tonnage.

200. Application for vessel with GT ≥ 500 engaged in international voyages

201. 1.4 This Code applies to high speed craft engaged in international voyages the keels of which are laid or which are at a similar stage of construction on or after 1 July 2002.

300. RBNA comment: Application for vessels with GT < 500 engaged in national or international voyages

301. In addition, these Rules also apply to:

- a. high speed craft engaged in national voyages;

- b. high speed craft having GT < 500.

302. Exemptions from some of the requirements of the Rules may be granted when particular circumstances (e.g. restricted services) warrant this, in the opinion of the RBNA

A3. DEFINITIONS

100. Terms

101. The terms employed in the present Section have the following definitions:

Category A machinery spaces: Machinery spaces of category A are those spaces and trunks to such spaces which contain:

- a. internal combustion machinery used for main propulsion;
- b. internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or
- c. any oil-fired boiler or oil fuel unit.

Control stations are those spaces in which the ship's radio or main navigating equipment or the emergency source of power is located or where the firefighting recording or fire control equipment is centralized.

Dead ship condition: The condition under which the main propulsion plant, boilers and auxiliaries are not in operation due to the absence of power.

Guidance

Dead ship condition is a condition in which the entire machinery installation, including the power supply, is out of operation and the auxiliary services such as compressed air, starting current from batteries etc., for bringing the main propulsion into operation and for the restoration of the main power supply are not available.

End of guidance

Loading area: is the part of the vessel containing cargo tanks, waste tanks and cargo pumps spaces, including cofferdams square, ballast tanks and void spaces adjacent to cargo tanks, as well as the areas of the deck along the entire length and breadth of the part of the vessel located above of these spaces mentioned.

Earthing connecting device to the hull or other structure permanently attached, used as an arbitrary zero potential in such a manner as will ensure at all times an immediate discharge of electrical energy without danger, in order to protect the individual against hazardous contacts with accidentally energized metal parts, which can cause injuries during a phase-earth fault.

Emergency condition is a condition under which any services needed for normal operational and habitable conditions are not in working order due to failure of the main source of electrical power.

Emergency consumers are mandatory consumers which, after breakdown of the main energy supply, shall be fed by the emergency energy supply.

Emergency switchboard is a switchboard which in the event of failure of the main electrical power supply system is directly supplied by the emergency source of electrical power or the transitional source of emergency power and is intended to distribute electrical energy to the emergency services.

Essential services: those who are constantly required to: navigation, propulsion, manoeuvring the ship's machine (rudder, windlass, mooring winch, impeller side), services of specialized ships (cargo refrigeration system, air conditioning systems in ships passengers, cargo pump system in oil tankers) and required for safety of life at sea.

Hazardous areas are areas in which an explosive atmosphere in dangerous quantity (a dangerous explosive atmosphere) is liable to occur owing to local and operating conditions. Hazardous areas are divided into zones depending on the probability that a dangerous explosive atmosphere may occur:

- d. Zone 0 comprises areas in which a dangerous explosive atmosphere is present either permanently or for long periods.
- e. Zone 1 comprises areas in which a dangerous explosive atmosphere is liable to occur occasionally.

- f. Zone 2 comprises areas in which a dangerous explosive atmosphere is liable to occur only rarely, and then only for a brief period (extended hazardous areas).

High voltage: high voltage circuits are those with more than 1000 V for alternating current and at least 1500 V for direct current.

Low-voltage systems: Are systems operating with rated voltages of more than 50 V. up to 1000 V. inclusive and with rated frequencies of 50 Hz or 60 Hz, or direct-current systems where the maximum instantaneous value of the voltage under rated operating conditions is greater than 50 V and not exceeding 1500 V.

Machinery spaces: all machinery spaces of category A and all other spaces containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

Main generating station is the space in which the main source of electrical power is situated.

Main source of electrical power is a source intended to supply electrical power to the main switchboard for distribution to all services necessary for maintaining the ship in normal operational and habitable conditions.

Main switchboard is a switchboard which is directly supplied by the main source of electrical power and is intended to distribute electrical energy to the ship's services.

Normal operational and habitable condition is a condition under which the ship as a whole, the machinery, services, means and aids ensuring propulsion, ability to steer, safe navigation, fire and flooding safety, internal and external communications and signals, means of escape, and emergency boat winches, as well as the designed comfortable conditions of habitability are in working order and functioning normally.

Emergency source of electrical power is a source of electrical power, intended to supply the emergency switchboard in the event of a failure of the supply from the main source of electrical power.

Dangerous goods: are those listed in the Chapter VII of the SOLAS 1974, as amended.

Hull return: a system in which insulated conductors are effectively connected to the mass of the ship for earthing.

Special category spaces: those enclosed spaces above or below the bulkhead deck intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion, to which such vehicles can be taken and removed them by their own means and to which the passengers have access.

Transient source of emergency power: accumulator batteries with sufficient capacity to supply automatically power for the emergency switchboard in the event of failure of main power source.

CHAPTER B DOCUMENTS, REGULATIONS AND STANDARDS

CHAPTER CONTENTS

- B1. DOCUMENTATION TO THE RBNA
- B2. REGULATION
- B3. STANDARDS AND UNITS

B3. STANDARDS AND UNITS

100. Standards

101. The electrical installations and all the equipment and materials to be employed on vessels covered by these Rules are to be designed, constructed and tested according to the latest revisions of the applicable Standards of the following organizations, in addition to the requirements laid down in these Rules:

- a. INMETRO: National Institute of Metrology, Standardization and Industrial Quality;
- b. ABNT: Brazilian Association of Technical Standards;
- c. IEC: International Electrotechnical Commission;
- d. ANSI: American National Standards Institute;
- e. NEMA: National Electrical Manufacturers Association;
- f. IEEE: Institute of Electrical and Electronics Engineers;

200. Units

201. Drawings and documents to be submitted to the RBNA are to have all the dimensions given in the international system. Consecrated dimensions in other systems of units should have indications of the corresponding values in the international system.

CHAPTER D PRINCIPLES OF CONSTRUCTION

CHAPTER CONTENTS

D1. GENERAL

D2. REQUIREMENTS FOR PASSENGER CRAFT

D1. 12.1 General

100. Electrical installations

101. 2.1.1 Electrical installations* shall be such that:

* Refer to the recommendations published by the International Electrotechnical Commission and, in particular, Publication 60092 - Electrical Installations in Ships.

- a. .1 all electrical auxiliary services necessary for maintaining the craft in normal operation and habitable conditions will be ensured without recourse to the emergency source of electrical power;
- b. .2 electrical services essential for safety will be ensured under various emergency conditions; and
- c. .3 the safety of passengers, crew and craft from electrical hazards will be ensured. The FMEA shall include the electrical system, taking into account the effects of electrical failure on the systems being supplied. In cases where faults can occur without being detected during routine checks on the installations, the analysis shall take into account the possibility of faults occurring simultaneously or consecutively.

102. 12.1.2 The electrical system shall be designed and installed so that the probability of the craft being at risk of failure of a service is extremely remote.

103. 12.1.3 Where loss of particular essential service would cause serious risk to the craft, the service shall be fed by at least two independent circuits fed in such a way that no single failure in the electrical supply or distribution systems would affect both supplies.

104. 12.1.4 The securing arrangements for heavy items, i.e. accumulator batteries, shall, as far as practicable, prevent excessive movement during the accelerations due to grounding or collision.

105. 12.1.5 Precautions shall be taken to minimise risk of supplies to essential and emergency services being interrupted by the inadvertent or accidental opening of switches or circuit-breakers.

D2. REQUIREMENTS FOR PASSENGER CRAFT

100. 12.7 General

101. 12.7.1 Separation and duplication of electrical supply shall be provided for duplicated consumers of essential services. During normal operation the systems may be connected to the same power-bus, but facilities for easy separation shall be provided. Each system shall be able to supply all equipment necessary to maintain the control of propulsion, steering, stabilization, navigation, lighting and ventilation, and allow starting of the largest essential electric motor at any load. Automatic load-dependent disconnection of non-essential consumers may be allowed.

CHAPTER F DESIGN AND CONSTRUCTION OF ELECTRIC POWER GENERATION SYSTEM

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- F1. ELECTRICAL LOAD ANALYSIS
See Part II, Title 11, Section 7
- F2. DIRECT CURRENT GENERATORS
See Part II, Title 11, Section 7
- F3. ALTERNATE CURRENT GENERATORS
See Part II, Title 11, Section 7
- F4. MAIN SOURCE OF ELECTRICAL POWER
AND LIGHTING SYSTEMS
- F5. EMERGENCY SOURCE OF ELECTRICAL
POWER
- F6. SHORE POWER SOURCE
See Part II, Title 11, Section 7
- F7. STEERING AND STABILIZATION

F4. MAIN SOURCE OF ELECTRICAL POWER AND LIGHTING SYSTEMS

100. 12.2 Main source of electrical power

101. 12.2.1 A main source of electrical power of sufficient capacity to supply all those services mentioned in D1.101 shall be provided. The main source of electrical power shall consist of at least two generating sets.

102. 12.2.2 The capacity of these generating sets shall be such that, in the event of any one generating set being stopped or failing, it will still be possible to supply those services necessary to provide the normal operational conditions of propulsion and safety. Minimum comfortable

conditions of habitability shall also be ensured which include at least adequate services for cooking, heating, domestic refrigeration, mechanical ventilation, and sanitary and fresh water.

103. 12.2.3 The arrangements of the craft's main source of electrical power shall be such that the services referred to in D1.100 can be maintained regardless of the speed and direction of the propulsion machinery or shafting.

104. 12.2.4 In addition, the generating sets shall be such as to ensure that, with any one generator or its primary source of power out of operation, the remaining generating set shall be capable of providing the electrical services necessary to start the main propulsion plant from dead craft condition. The emergency source of electrical power may be used for the purpose of starting from a dead craft condition if its capability either alone or combined with that of any other source of electrical power is sufficient to provide at the same time those services required to be provided by F5.303.a. to F5.303.c. to F5.304.a. to F5.304.a., as appropriate.

105. 12.2.5 Where transformers constitute an essential part of the electrical supply system required by this section, the system shall be so arranged as to ensure the same continuity of supply as is stated in F4.100.

106. 12.2.6 A main electric lighting system which shall provide illumination throughout those parts of the craft normally accessible to and used by passengers and crew shall be supplied from the main source of electrical power.

107. 12.2.7 The arrangement of the main electric lighting system shall be such that a fire or other casualty in spaces containing the emergency source of electrical power, associated transforming equipment, if any, the emergency switchboard and the emergency lighting switchboard will not render inoperative the main electric lighting systems required by F4.106.

108. 12.2.8 The main switchboard shall be so placed relative to one main generating station that, as far as practicable, the integrity of the normal electrical supply may be affected only by a fire or other casualty in one space. An environmental enclosure for the main switchboard, such as may be provided by the machinery control room situated within the main boundaries of the space, shall not be considered as separating the switchboards from the generators.

109. 12.2.9 The main busbars shall be subdivided into at least two parts which shall be connected by a circuit-breaker or other approved means. So far as is practicable, the connection of generating sets and any other duplicated equipment shall be equally divided between the parts. For category B craft, each part of the main busbars with its associated generators shall be arranged in separate compartments.

F5. EMERGENCY SOURCE OF ELECTRICAL POWER

100. 12.3 Emergency source of electrical power

101. 12.3.1 A self-contained emergency source of electrical power shall be provided

102. 12.3.2 The emergency source of electrical power, associated transforming equipment, if any, transitional source of emergency electrical power, emergency switchboard and emergency lighting switchboard shall be located above the waterline in the final condition of damage as referred to in PII, T25, S1 operable in that condition and readily accessible.

103. 12.3.3 The location of the emergency source of electrical power and associated transforming equipment, if any, the transitional source of emergency power, the emergency switchboard and the emergency electrical lighting switchboards in relation to the main source of electrical power, associated transforming equipment, if any, and the main switchboard shall be such as to ensure that a fire or other casualty in spaces containing the main source of electrical power, associated transforming equipment, if any, and the main switchboard or in any machinery space will not interfere with the supply, control, and distribution of emergency electrical power. As far as practicable, the space containing the emergency source of electrical power, associated transforming equipment, if any, the transitional source of emergency electrical power and the emergency switchboard shall not be contiguous to the boundaries of the main machinery spaces or those spaces containing the main source of electrical power, associated transforming equipment, if any, or the main switchboard.

104. 12.3.4 Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency generator, if provided, may be used exceptionally, and for short periods, to supply non-emergency circuits.

105. 12.3.5 Distribution systems shall be so arranged that the feeders from the main and emergency sources are separated both vertically and horizontally as widely as practicable.

106. 12.3.6 The emergency source of electrical power may be either a generator or an accumulator battery, which shall comply with the following:

- a. .1 Where the emergency source of electrical power is a generator, it shall be:
 - a.1. .1.1 driven by a suitable prime mover with an independent supply of fuel having a flashpoint which meets the requirements of PII, T25, S3, E1.102.b;
 - a.2. .1.2 started automatically upon failure of the electrical supply from the main source of

electrical power and shall be automatically connected to the emergency switchboard.

- a.3. Those services referred to in D2.400 or F5.400 shall then be transferred to the emergency generating set. The automatic starting system and the characteristic of the prime mover shall be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 seconds; and

- a.4. .1.3 provided with a transitional source of emergency electrical power according to D2.400 or F5.400.

- b. .2 Where the emergency source of electrical power is an accumulator battery, it shall be capable of:

- b.1. .2.1 carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage;

- b.2. .2.2 automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and

- b.3. .2.3 immediately supplying at least those services specified in D2.400 or F5.400.

107. 12.3.7 The emergency switchboard shall be installed as near as is practicable to the emergency source of electrical power.

108. 12.3.8 Where the emergency source of electrical power is a generator, the emergency switchboard shall be located in the same space unless the operation of the emergency switchboard would thereby be impaired.

109. 12.3.9 No accumulator battery fitted in accordance with this section shall be installed in the same space as the emergency switchboard. An indicator shall be mounted in a suitable space at the craft's operating compartment to indicate when the batteries constituting either the emergency source of electrical power or the transitional source of emergency electrical power referred to in F5.106.a.iii are being discharged.

110. 12.3.10 The emergency switchboard shall be supplied during normal operation from the main switchboard by an interconnector feeder which shall be adequately protected at the main switchboard against overload and short circuit and which shall be disconnected automatically at the emergency switchboard upon failure of the main source of electrical power. Where the system is arranged for feedback operation, the interconnector feeder shall also be protected at the emergency switchboard at least against short circuit. Failure of the emergency switchboard,

when being used in other than an emergency, shall not put at risk the operation of the craft.

111. 12.3.11 In order to ensure ready availability of the emergency source of electrical power, arrangements shall be made, where necessary, to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that power shall be available to the emergency circuits.

112. 12.3.12 The emergency generator and its prime mover and any emergency accumulator battery shall be so designed and arranged as to ensure that they will function at full rated power when the craft is upright and when the craft has a list or trimming accordance with PII, T25, S5, D2.112 including any damage cases considered in PII, T25, S1, or is in any combination of angles within those limits.

113. 12.3.13 Where accumulator batteries are installed to supply emergency services, provisions shall be made to charge them in situ from a reliable on-board supply. Charging facilities shall be so designed to permit the supply of services, regardless of whether battery is on charge or not. Means shall be provided to minimise the risk of overcharging or overheating the batteries. Means for efficient air ventilation shall be provided.

200. 12.4 Starting arrangements for emergency generating sets

201. 12.4.1 Emergency generating sets shall be capable of being readily started in their cold condition at a temperature of 0°C. If this is impracticable, or if lower temperatures are likely to be encountered, provisions shall be made for heating arrangements to ensure ready starting of the generating sets.

202. 12.4.2 Each emergency generating set shall be equipped with starting devices with a stored energy capability of at least three consecutive starts. The source of stored energy shall be protected to preclude critical depletion by the automatic starting system, unless a second independent means of starting is provided. A second source of energy shall be provided for an additional three starts within 30 min, unless manual starting can be demonstrated to be effective.

203. 12.4.3 The stored energy shall be maintained at all times, as follows:

- a. .1 electrical and hydraulic starting systems shall be maintained from the emergency switchboard;
- b. .2 compressed air starting systems may be maintained by the main or auxiliary compressed air receivers through a suitable nonreturn valve or by an emergency air compressor which, if electrically driven, is supplied from the emergency switchboard;
- c. .3 all of these starting, charging and energy-storing devices shall be located in the emergency generator space. These devices shall not be used for any

purpose other than the operation of the emergency generating set. This does not preclude the supply to the air receiver of the emergency generating set from the main or auxiliary compresses air system through the non return valve fitted in the emergency generator space.

300. 12.7.2 Emergency source of electrical power in passenger ships

301. Where the main source of electrical power is located in two or more compartments which are not contiguous, each of which has its own self-contained systems, including power distribution and control systems, completely independent of each other and such that a fire or other casualty in any one of the spaces will not affect the power distribution from the others, or to the services required by F5.303 or F5.304, the requirement of F5.101, F5.102 and F5.104 may be considered satisfied without an additional emergency source of electrical power, provided that:

- a. .1 there is at least one generating set, meeting the requirements of F5.112 and of sufficient capacity to meet the requirements of F5.303. or F5.304. in each of at least two non-contiguous spaces;
- b. .2 the arrangements required by .1 in each such space are equivalent to those required by F5.106.a., F5.107 to F5.111 and F5.200 so that a source of electrical power is available at all times to the services required by F5.303 or F5.304; and
- c. .3 the generator sets referred to in .1 and their self-contained systems are installed such that one of them remains operable after damage or flooding in any one compartment.

303. 12.7.3 For category A craft, the emergency source of power shall be capable of supplying simultaneously the following services:

- a. .1 for a period of 5 h emergency lighting:
 - a.1. .1.1 at the stowage, preparation, launching and deployed positions of survival craft and equipment for embarkation into those craft;
 - a.2. .1.2 at all escape routes, such as alleyways, stairways, exits from accommodation and service spaces, embarkation points, etc;
 - a.3. .1.3 in the public spaces;
 - a.4. .1.4 in the machinery spaces and main emergency generator spaces, including their control positions;
 - a.5. .1.5 in control stations;
 - a.6. .1.6 at the stowage positions for firemen' s outfits; and

- a.7. .1.7 at the steering gear;
- b. .2 for a period of 5 h;
- b.1. .2.1 main navigation lights, except for "not under command" lights;
- b.2. .2.2 electrical internal communication equipment for announcements for passengers and crew required during evacuation;
- b.3. .2.3 fire-detection and general alarm system and manual fire alarms; and
- b.4. .2.4 remote control devices of fire-extinguishing systems, if electrical;
- c. .3 for a period of 4 h of intermittent operation:
- c.1 .3.1 the daylight signalling lamps, if they have no independent supply from their own accumulator battery; and
- c.2 .3.2 the craft's whistle, if electrically driven;
- d. .4 for a period of 5 h;
- d.1. .4.1 craft radio facilities and other loads as set out in 14.13.2; and
- d.2. .4.2 essential electrically powered instruments and controls for propulsion machinery, if alternate sources of power are not available for such devices;
- e. .5 for a period of 12 h, the "not under command" lights; and
- f. .6 for a period of 10 min:
- f.1. .6.1 power drives for directional control devices, including those required to direct thrust forward and astern, unless there is a manual alternative acceptable to the Administration as complying with 5.2.3.
304. 12.7.4 For category B craft, 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. The emergency source of electrical power shall be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation.
- a. .1 for a period of 12 h, emergency lighting:
- a.1. .1.1 at the stowage, preparation, launching and deployed positions of survival craft and equipment for embarkation into those craft;
- a.2. .1.2 at all escape routes, such as alleyways, stairways, exits from accommodation and service spaces, embarkation points, etc;
- a.3. .1.3 in the passenger compartments;
- a.4. .1.4 in the machinery spaces and main emergency generating spaces including their control positions;
- a.5. .1.5 in control stations;
- a.6. .1.6 at the stowage positions for firemen's outfits; and
- a.7. .1.7 at the steering gear;
- b. .2 for a period of 12 h;
- b.1. .2.1 the navigation lights, and other lights required by International Regulations for Preventing Collisions at Sea in force;
- b.2. .2.2 electrical internal communication equipment for announcements for passengers and crew required during evacuation;
- b.3. .2.3 fire-detection and general alarm system and manual fire alarms; and
- b.4. .2.4 remote control devices of fire-extinguishing systems, if electrical;
- c. .3 for a period of 4 h on intermittent operation:
- c.1 .3.1 the daylight signalling lamps, if they have no independent supply from their own accumulator battery; and
- c.2 .3.2 the craft's whistle, if electrically driven;
- d. .4 for a period of 12 h;
- d.1. .4.1 the navigational equipment as required by chapter 13. Where such provision is unreasonable or impracticable, the Administration may waive this requirement for craft of less than 5,000 gross tonnage;
- d.2. .4.2 essential electrically powered instruments and controls for propulsion machinery, if alternate sources of power are not available for such devices;
- d.3. .4.3 one of the fire pumps required by PII,T25,S3,E7.700;

- d.4. .4.4 the sprinkler pump and drencher pump, if fitted;
- d.5. .4.5 the emergency bilge pump and all the equipment essential for the operation of electrically powered remote controlled bilge valves.
- d.6. .4.6 craft radio facilities and other loads.
- e. 5 for a period of 30 min, any watertight doors, required by PII,T25, S1, to be power-operated, together with their indicators and warning signals;
- f. .6 for a period of 10 min, power drives for directional control devices including those required to direct thrust forward and astern, unless there is a manual alternative acceptable to the Administration.

400. 12.7.5 Transitional source of emergency electrical power

401. The transitional source of emergency electrical power required by paragraph F4.106.a3. may consist of an accumulator battery suitably located for use in an emergency which shall operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage and be of sufficient capacity and so arranged as to supply automatically in the event of failure of either the main or emergency source of electrical power at least the following services, if they depend upon an electrical source for their operation:

- a. .1 for a period of 30 min, the load specified in F5.303,
- b. .2 and .3, or in F5.304, .2 and .3; and .2 with respect to the watertight doors:
 - b.1. .2.1 power to operate the watertight doors, but not necessarily simultaneously, unless an independent temporary source of stored energy is provided. The power source shall have sufficient capacity to operate each door at least three times, i.e. closed-open-closed, against an adverse list of 15°; and
 - b.2. .2.2 power to the control, indication and alarm circuits for the watertight doors for half an hour.

402. 12.7.6 The requirements of F5.400 may be considered satisfied without the installation of a transitional source of emergency electrical power if each of the services required by that paragraph have independent supplies, for the period specified, from accumulator batteries suitably located for use in an emergency. The supply of emergency power to the instruments and controls of the propulsion and direction systems shall be uninterrupted.

403. 12.7.7 In category A craft having limited public spaces, emergency lighting fittings of the type described in F5.405.a. as meeting the requirements of F5.303.a. and F5.401.a. may be accepted, provided that an adequate standard of safety is attained.

404. 12.7.8 Provisions shall be made for the periodic testing of the complete emergency system, including the emergency consumers required by F5.303 or F5.304 and F5.400, and shall include the testing of automatic starting arrangements.

405. 12.7.9 In addition to the emergency lighting required by paragraph F5.303.a., F5.304.a and F5.400.a.on every craft with ro-ro spaces:

- a. .1 all passenger public spaces and alleyways shall be provided with supplementary electric lighting that can operate for at least three h when all other sources of electric power have failed and under any condition of heel. The illumination provided shall be such that the approach to the means of escape can be readily seen. The source of power for the supplementary lighting shall consist of accumulator batteries located within the lighting units that are continuously charged, where practicable, from the emergency switchboard. Alternatively, any other means of lighting, which is at least as effective, may be accepted by the Administration. The supplementary lighting shall be such that any failure of the lamp will be immediately apparent. Any accumulator battery provided shall be replaced at intervals having regard to the specified service life in the ambient condition that it is subject to in service; and
- b. .2 a portable rechargeable battery-operated lamp shall be provided in every crew space alleyway, recreational space and every working space which is normally occupied unless supplementary emergency lighting, as required by .1, is provided.

406. 12.7.10 Distribution systems shall be so arranged that fire in any main vertical zone will not interfere with services essential for safety in any other such zone. This requirement will be met if main and emergency feeders passing through any such zone are separated both vertically and horizontally as widely as is practicable.

500. Requirements for cargo craft

501. 10.10 Bilge pumping systems

502. 10.10.1 At least two power pumps connected to the main bilge system shall be provided, one of which may be driven by the propulsion machinery. If the Administration is satisfied that the safety of the craft is not impaired, bilge pumping arrangements may be dispensed with in particular compartments. Alternatively, the arrangement may be in accordance with the requirements of 10.3.14.

503. 10.10.2 On multihull craft each hull shall be provided with at least two power pumps, unless a bilge pump in one

hull is capable of pumping bilge in the other hull. At least one pump in each hull shall be an independent power pump.

F7. 12.5 STEERING AND STABILIZATION

100. Steering and stabilization

101. 12.5.1 Where steering and/or stabilization of a craft is essentially dependent on one device as with a single rudder or pylon, which is itself dependent on the continuous availability of electric power, it shall be served by at least two independent circuits, one of which shall be fed either from the emergency source of electric power or from an independent power source located in such a position as to be unaffected by fire or flooding affecting the main source of power. Failure of either supply shall not cause any risk to the craft or passengers during switching to the alternative supply and such switching arrangements shall meet the requirements in PII, T25, S5. These circuits shall be provided with short-circuit protection and an overload alarm.

102. 12.5.2 Protection against excess current may be provided, in which case it shall be for not less than twice the full load current of the motor or circuit so protected and shall be arranged to accept the appropriate starting current with a reasonable margin. Where three-phase supply is used an alarm shall be provided in a readily observed position in the craft's operating compartment that will indicate failure of any one of the phases.

103. 12.5.3 Where such systems are not essentially dependent on the continuous availability of electric power but at least one alternative system, not dependent on the electric supply, is installed, then the electrically powered or controlled system may be fed by a single circuit protected in accordance with F7.103.

104. 12.5.4 The requirements of PII, T25, S8 for power supply of the directional control system and stabilising system of the craft shall be met.

CHAPTER G DESIGN AND CONSTRUCTION OF ELECTRIC POWER DISTRIBUTION SYSTEM

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G7. PRECAUTIONS AGAINST SHOCK, FIRE AND OTHER HAZARDS OF ELECTRICAL ORIGIN

100. 12.6 Precautions against shock, fire and other hazards of electrical origin

101. 12.6.1.1 Exposed metal parts of electrical machines or equipment which are not intended to be live but which are liable under fault conditions to become live shall be earthed unless the machines or equipment are:

- a. .1 supplied at a voltage not exceeding 50 V direct current or 50 V, root-mean-square between conductors; auto-transformers shall not be used for the purpose of achieving this voltage; or
- b. .2 supplied at a voltage not exceeding 250 V by safety isolating transformers supplying only one consuming device; or
- c. .3 constructed in accordance with the principle of double insulation.

102. 12.6.1.2 The Administration may require additional precautions for portable electrical equipment for use in confined or exceptionally damp spaces where particular risks due to conductivity may exist

103. 12.6.1.3 All electrical apparatus shall be constructed and so installed as not to cause injury when handled or touched in the normal manner.

104. 12.6.2 Main and emergency switchboards shall be so arranged as to give easy access, as may be needed, to

apparatus and equipment, without danger to personnel. The sides and the rear and, where necessary, the front of switchboards shall be suitably guarded. Exposed live parts having voltages to earth exceeding a voltage to be specified by the Administration shall not be installed on the front of such switchboards. Where necessary, nonconducting mats or gratings shall be provided at the front and rear of the switchboard.

105. 12.6.3 When a distribution system, whether primary or secondary, for power, heating or lighting, with no connection to earth is used, a device capable of continuously monitoring the insulation level to earth and of giving an audible or visual indication of abnormally low insulation values shall be provided. For limited secondary distribution systems the Administration may accept a device for manual checking of the insulation level.

200. 12.6.4 Cables and wiring

201. 12.6.4.1 Except as permitted by the Administration in exceptional circumstances, all metal sheaths and armour of cables shall be electrically continuous and shall be earthed.

202. 12.6.4.2 All electric cables and wiring external to equipment shall be at least of a flame-retardant type and shall be so installed as not to impair their original flame-retarding properties. Where necessary for particular applications, the Administration may permit the use of special types of cables such as radio-frequency cables, which do not comply with the foregoing.

203. 12.6.4.3 Cables and wiring serving essential or emergency power, lighting, internal communications or signals shall, as far as practicable, be routed clear of machinery spaces and their casings and other areas of high fire risk. Where practicable, all such cables shall be run in such a manner as to preclude their being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space.

245. 12.6.4.4 Where cables which are installed in hazardous areas introduce the risk of fire or explosion in the event of an electrical fault in such areas, special precautions against such risks shall be taken to the satisfaction of the Administration.

205. 12.6.4.5 Cables and wiring shall be installed and supported in such manner as to avoid chafing or other damage.

206. 12.6.4.6 Terminations and joints in all conductors shall be so made as to retain the original electrical, mechanical, flame-retarding and, where necessary, fire-resisting properties of the cable.

207. 12.6.5.1 Each separate circuit shall be protected against short circuit and against overload, except as permitted in F7.101 or where the Administration may exceptionally otherwise permit.

208. 12.6.5.2 The rating or appropriate setting of the overload protective device for each circuit shall be permanently indicated at the location of the protective device.

209. 12.6.6 Lighting fittings shall be so arranged as to prevent temperature rises which could damage the cables and wiring, and to prevent surrounding material from becoming excessively hot.

210. 12.6.7 All lighting and power circuits terminating in a bunker or cargo space shall be provided with a multiple-pole switch outside the space for disconnecting such circuits.

211. 12.6.8.1 Accumulator batteries shall be suitably housed, and compartments used primarily for their accommodation shall be properly constructed and efficiently ventilated.

212. 12.6.8.2 Electrical or other equipment which may constitute a source of ignition of flammable vapours shall not be permitted in these compartments except as permitted in 12.6.9.

213. 12.6.8.3 Accumulator batteries shall not be located in crew accommodation.

214. 12.6.9 No electrical equipment shall be installed in any space where flammable mixtures are liable to collect, including those in compartments assigned principally to accumulator batteries, in paint lockers, acetylene stores or similar spaces, unless the Administration is satisfied that such equipment is:

- a. .1 essential for operational purposes;
- b. .2 of a type which will not ignite the mixture concerned;
- c. .3 appropriate to the space concerned; and
- d. .4 appropriately certified for safe usage in the dusts, vapours or gases likely to be encountered.

215. 12.6.10 The following additional requirements from .1 to .7 shall be met, and requirements from .8 to .13 shall be met also for non-metallic craft:

- a. .1 The electrical distribution voltages throughout the craft may be either direct current or alternating current and shall not exceed:
 - a.1. .1.1 500 V for cooking, heating and other permanently connected equipment; and
 - a.2. .1.2 250 V for lighting, internal communications and receptacle outlets.
 - a.3. The Administration may accept higher voltages for propulsion purposes.

- b. .2 For electrical power distribution, two-wire or three-wire systems shall be used. Four-wire systems with neutral solidly earthed but without hull return may also be used. Where applicable, the requirements for PII, T25, S7, E5.106.d. or for PII, T25, S7, E5.106.e. shall also be met.
- c. .3 Effective means shall be provided so that voltage may be cut off from each and every circuit and sub-circuit and from all apparatus as may be necessary to prevent danger.
- d. .4 Electrical equipment shall be so designed that the possibility of accidentally touching live parts, rotating or moving parts as well as heated surfaces which might cause burns or initiate fire is minimized.
- e. .5 Electrical equipment shall be adequately secured. The probability of fire or dangerous consequences arising from damage to electrical equipment shall be reduced to an acceptable minimum.
- f. .6 The rating or appropriate setting of the overload protective device for each circuit shall be permanently indicated at the location of the protection device.
- g. .7 Where it is impracticable to provide electrical protective devices for certain cables supplied from batteries, e.g., within battery compartments and in engine starting circuits, unprotected cable runs shall be kept as short as possible and special precautions shall be taken to minimize risk of faults, e.g., use of single-core cables with additional sleeve over the insulation of each core, with shrouded terminals.
- h. .8 In order to minimize the risk of fire, structural damage, electrical shock and radio interference due to lightning strike or electrostatic discharge, all metal parts of the craft shall be bonded together, in so far as possible in consideration of galvanic corrosion between dissimilar metals, to form a continuous electrical system, suitable for the earth return of electrical equipment and to connect the craft to the water when water-borne. The bonding of isolated components inside the structure is not generally necessary, except in fuel tanks.
- i. .9 Each pressure refuelling point shall be provided with a means of bonding the fuelling equipment to the craft.
- j. .10 Metallic pipes capable of generating electrostatic discharges, due to the flow of liquids and gases, shall be bonded so as to be electrically continuous throughout their length and shall be adequately earthed.
- k. .11 Primary conductors provided for lightning discharge currents shall have a minimum cross-section of 70 mm² in copper or equivalent surge-carrying capacity in aluminium.
- l. .12 Secondary conductors provided for the equalisation of static discharges, bonding of equipment, etc., but not for carrying lightning discharges shall have a minimum cross section of 5 mm² copper or equivalent surge current carrying capacity in aluminium.
- m. .13 The electrical resistance between bonded objects and the basic structure shall not exceed 0.02 Ohm except where it can be demonstrated that a higher resistance will not cause a hazard. The bonding path shall have sufficient cross-sectional area to carry the maximum current likely to be imposed on it without excessive voltage drop.

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