RULES
FOR THE CLASSIFICATION AND CONSTRUCTION OF MOTOR BOATS

PART V
ELECTRICAL INSTALLATIONS

January
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GDAŃSK

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF MOTOR BOATS consist of the following, separately issued, Parts:

Part I – Classification Regulations
Part II – Hull
Part III – Equipment and Stability
Part IV – Machinery Installations
Part V – Electrical Installations
Part VI – Materials

Part V – Electrical Installations – January 2021 was approved by the PRS Board on 21 December 2020 and enters into force on 1 January 2021.

From the entry into force, the requirements of the present Part of the *Rules* apply to:
– motor boats under construction – within the full scope,
– motor boats in service – at their conversion and general overhaul, as well as in each justified case.

For other motor boats in service, the *Rules* requirements valid at the assignment of PRS class to a motor boat, apply.

PRS/RP, 12/2020

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1 GENERAL

1.1 Application

1.1.1 The requirements of *Part V – Electrical Installations of the Rules for the Classification and Construction of Motor Boats* (hereinafter referred to as the Rules) are applicable to safety voltage electrical installations, as well as to electrical installations operating at higher voltages intended to supply appliances which do not affect the safety of motor boat sailing and its manoeuvring capability, installed on motor boats specified in *Part I – Classification Regulations*.

1.1.2 Where electrical installations operating at a voltage exceeding the safe voltage, intended to supply appliances which affect the safety of motor boat sailing and its maneuvering capability, are installed, the following shall be additionally complied with: the requirements of *Part VII – Electrical Equipment and Automation* of the *Rules for the Classification and Construction of Inland Waterways Vessels* with respect to inland waterways boats and the requirements of *Part VII – Electrical Installations and Control Systems* of the *Rules for the Classification and Construction of Small Sea-going Ships* with respect to coastal boats.

1.1.3 In well-justified cases, PRS may give consent to the departure from the requirements of the present *Part* or may extend the scope of the requirements in the case of, for example, novel or untypical designs application.

1.1.4 It is recommended that the electrical equipment, used on board, should comply with the requirements of the relevant harmonized standards under Directive 2013/53/UE or other national or international standards, indicated by PRS.

1.2 Definitions

Starter battery – a battery intended for starting the propulsion or auxiliary engine.

Service accumulator – an accumulator intended for power supply to the equipment affecting the safety of navigation, the windlass, thruster and other appliances, as well as for emergency starting of the propulsion or auxiliary engine.

Accumulator battery – accumulators connected in series to increase voltage or connected in parallel to increase capacity.

Inverter – a device which transforms direct current into alternating current. The purpose of the inverter is to supply alternating current to electrical equipment where the boat is not fitted with a generating set or the generating set is out of service.

Galvanic isolator – a device installed in series in the AC protective conductor of the shore-power cable to resist stray and low voltage DC galvanic current flow while permitting the passage of alternating current.

Rectifier – a device that changes an AC voltage to DC, intended for charging accumulators, capable of manual or automatic charging rate control.

Safety voltage – any voltage not causing potential danger of electric shock or burn in normal conditions, the value of which does not exceed 50 V between conductors for direct current or 50 V (in isolated circuit) between conductors or between the hull/earth and the phase for alternating current.

Earth plate – an element made of metal having high resistance to corrosion, secured to the hull plating in such a way that it is immersed in water in all sailing conditions.

Protective earthing conductor (PE) – a conductor, not normally carrying current, used for protection against electric shock, by electrically connecting any exposed conductive parts of AC electrical equipment to the boat's ground and to the shore grounding conductor through the shore power cable.

Equipotential bonding conductor – a conductor, not normally carrying current, used for putting different exposed conductive parts of DC electrical equipment and external conductive parts almost at the same potential.

Shore connection – an enclosed or sheltered connection point installed in the boat, terminated with a socket outlet or connection strip, used only for the connection of power supply from shore. The flexible shore power cable shall be terminated with a plug or shall be fitted with suitable terminals.

Switchboard – assembly of devices for the purpose of controlling and/or distributing electrical power.

Earthing – metallic connection of equipment terminal with the boat's metal hull. On boats having non-metallic hulls, earthing is effected by connection of equipment terminal or a busbar with earth plate.

Essential equipment – equipment which, under normal operation, ensures safe navigation and safety of human life on board the boat. These are:
– navigation lights;
– illumination of compass and panel;
– VHF radiotelephone;
– GPS or other positioning system;
– active radar reflector;
– whistle;
– lighting of chart room;
– bilge pumps;
– steering gear;
– fire detection signal.

1.3 Scope of Survey

1.3.1 The general provisions relating to the classification procedure, motor boat construction survey, survey activities, as well as the requirements regarding the documentation to be submitted to PRS for consideration and approval are given in *Part I – Classification Regulations.*

1.3.2 It is recommended that the following electrical equipment shall be installed on a motor boat under PRS' survey:
– sources of electrical power;
– switchboards;
– electric drives of: thruster, deck winches, capstans and pumps;
– electric ligthing;
– navigation lights;
– cabling;
– other, not listed above, systems and appliances, specified by PRS.

1.4 Documentation

1.4.1 The motor boat shall be provided with up-to-date diagram of electrical installation showing all circuits, location of electrical equipment, identification of the used conductors, switches, contactors, relays and fuses, as well as the description of the symbols used.

2 GENERAL REQUIREMENTS

2.1 Operating Conditions

2.1.1 Electrical equipment installed on motor boat shall be capable of reliable operation in the following conditions:
– ambient air temperature in spaces: from 0 to +45°C;
– ambient temperature on open deck: from -25 to +45°C;
– continuous heel of up to 15°;
– short time heel of up to 30°;
– short time longitudinal inclination of up to 20°.

2.1.2 The electrical equipment placed in locations subject to heavy vibrations and shocks shall be so designed as to be capable of normal operation under such conditions or shall be mounted on suitable shock absorbers.

2.2 Materials

2.2.1 The structural parts of electrical equipment shall be made of metal or not readily ignitable insulating materials, resistant to marine atmosphere and oil vapours effects or they shall be reliably protected against such effects.

2.2.2 All current-carrying parts of electrical equipment shall made of copper, copper alloys or other materials having equivalent qualities.

2.2.3 Studs, nuts, washers and clamps used for cable connection shall be made of materials resistant to corrosion and shall not cause cable electrochemical corrosion. They shall not be made from aluminium alloy or unplated steel.

2.3 Arrangement of Electrical Equipment

2.3.1 Electrical equipment shall be installed in such a manner as to provide easy access to control elements and to all parts that require maintenance, inspection and replacement.

2.3.2 Electrical equipment shall be efficiently protected against temperature rise caused by external sources of heat so that the permissible temperature limit will not be exceeded.

2.3.3 Electrical equipment shall be fixed in position in such a manner that the fastening method does not reduce the strength and watertightness of hull plating, deck or bulkhead.

2.3.4 Electrical equipment shall not be installed closer than 75 mm to the fuel tanks walls.

2.3.5 Generators, starters and other electrical equipment driven by internal combustion engine shall be so installed as to be above the expected bilge water level and spaced, as far as practicable, from the fuel system.

2.4 Marking of Electrical Equipment and Conductors

2.4.1 It is recommended that all consumers installed on the motor boat operating at a voltage higher than the safety voltage should be provided with EC marking in accordance with Low Voltage Directive 2014/35/UE.

2.4.2 Electrical apparatus and equipment installed on the motor boat shall be provided with plates stating the rated voltage and the rated current. For AC equipment, frequency and the number of phases shall be additionally given.

2.4.3 Enclosures and shielding of electrical equipment intended for generating, converting and distribution of electrical power, operating at a voltage higher than the safety voltage shall be marked with a high voltage electric shock hazard warning.

2.4.4 Electrical equipment for which specific polarization of power supply connection and earthing is required shall be appropriately marked.

2.4.5 Accumulator batteries shall be visibly marked with polarity and ratings: voltage, capacity and the starting current.

2.4.6 All electrical conductors which are part of the electrical system (direct current and alternating current) shall be identified by colour of insulation, colour or marking of ends, or shall be identified, in an explicit and legible manner, using other means. The following colour identification of conductor insulation is recommended:

– live conductors: black or brown;

– neutral conductors: white or light blue;
– protective conductors: green or green with a yellow stripe.

It is recommended that on motor boats with AC and DC systems, the use of brown, white or light blue insulation colour in DC system should be avoided unless the conductors are clearly separated from AC conductors and identified.

Yellow, green or green with a yellow stripe insulation shall not be used for live conductors or neutral conductors of AC system.

2.5 Degrees of Enclosures Protection

2.5.1 Electrical equipment shall be provided with appropriate protective enclosures depending on their location or other suitable measures shall be taken to protect the equipment from harmful effect of the environment.

2.5.2 The minimum degree of protection of electrical equipment installed on the motor boat shall be chosen in accordance with Table 2.5.2.

Table 2.5.2

Item	Location of electrical equipment	Equipment location charactristics	Designation of degree of protection
1	Sheltered spaces below deck	Dry spaces	IP 20
2	Parts of spaces and rooms close to entrances to open deck	Possibility of liquid drops or sprays	IP 23
3	Engine compartments, galleys, bathrooms	Danger of liquid occurrence and mechanical damage	IP 44
4	Decks, holds	Danger of liquid spray and mechanical damage	IP 56
5	Open decks	Immersion of short duration	IP 67

2.6 Electrical Equipment in Explosion Hazardous Spaces

2.6.1 Electrical equipment installed in spaces containing petrol engines and petrol cylinders, LPG cylinders spaces or in other spaces where flammable gases may accumulate shall be of flameproof type in accordance with PN-EN 28846 or IEC60079-0.

2.7 Earthing and Equipotential Bonding

2.7.1 Exposed metal parts of electrical equipment which are touched during service and which may become live under fault conditions shall be connected to earth. Earthing connection is not required in the case of:

.1 electrical equipment supplied at safe voltage;
.2 electrical equipment provided with double or strengthened insulation.

2.7.2 The active area of earthing plate shall be not less than 0.1 m^2 ; the thickness of the earthing plate shall be not less than 2 mm. It is recommended to use earthing plates made of porous copper alloys. Earthing plate shall not be installed in the vicinity of propeller and log converters or echo sounder. In lieu of earthing plate, a metal part of the permanently submerged boat structure (e.g. rudder blade, shaft bracket) may be used.

2.7.3 The connection of: earthing, bonding or protective conductor to the boat's metal hull or to earthing plate shall be made at a location above the anticipated bilge water level.

2.7.4 On non-metallic motor boats, it is recommended that bonding conductors should be used between blocks of propulsion or auxiliary engines and metal parts of the fuel system. The bonding conductor shall be connected to earth plate or a permanently submerged metal part of the hull structure.

2.7.5 On motor boats fitted with petrol engines, the fuel metal cylinder, the stub pipe and any other metal part of the fuel flow pipe, which may be in contact with fuel, shall be connected by bonding conductor and earthed. The end of bonding conductor shall not be inserted between the elastic pipe and the stub pipe.

2.7.6 Earthing shall be made using copper conductor with the cross-section not less than that given in Table 2.7.6.

Table 2.7.6

The cross-section of cable conductor connected to item of equipment, [mm^2]	The cross-section of equipment earthing conductor, minimum [mm^2]
Up to 2.5	Single-wire conductor 2.5 Multi-wire-conductor 1.5
Over 2.5 to 120	Half the cross-section of a cable conductor connected, but not less than 4
Above 120	70

2.7.7 The resistance of connection between any part of enclosure of equipment which shall be earthed, any part of the bonding or protective connection and earthing plate or metal hull shall not exceed 1 Ohm.

2.7.8 In order to minimize interferences, it is recommended that the earthing conductors of radio and navigation equipment should be connected to a separate earthing pin or a separate earthing plate.

2.7.9 Screens and the metal sheath of cables, if applied, shall be earthed. The earthing shall be made at both ends of a cable, except cables in final sub-circuits which are permitted to be earthed on the supply end only.

2.7.10 Superstructures of aluminium alloys fastened to the boat's steel hull, but insulated therefrom, shall be earthed with at least two conductors having a cross-section not less than 16 mm^2.

2.7.11 To prevent electrolytic corrosion, it is recommended that a galvanic isolator complying with the requirements of PN-EN ISO 13297 should be installed in the shore power supply protective conductor. The galvanic isolator resists stray galvanic current flow while permitting the passage of alternating current, if present.

2.8 Lightning Protection

2.8.1 It is recommended that motor boats should be provided with lightning protection complying with the requirements of ISO 10134.

2.8.2 It is recommended that the lightning spike should be connected to a separate earth plate or a separate earthing pin.

3 SOURCES OF ELECTRICAL POWER

3.1 General Requirements

3.1.1 The source of electrical power on the motor boat may be:
- an accumulator battery;
- the propulsion engine driven generator (altenator);
- a generator with an independent prime mover (e.g. a generating set) ;
- a solar battery (if adequate battery charging is ensured).

3.1.2 The capacity of the electrical power source shall be sufficient for supplying all electrical equipment on board under all operating conditions.

3.1.3 For the propulsion engine starting system, two starter accumulators shall be provided, each one of sufficient capacity for ensuring 6 consecutive starts of 5 seconds duration. Where two or more engines are fitted, the capacity of the accumulator shall be sufficient to ensure at least 3 starts of each engine.

3.1.4 One of the starter accumulators may also serve as service accumulator, i.e. may be used for supplying the boat's electrical services. The capacity of an accumulator used for supplying both starting system and other services shall be suitably increased to make it capable of supplying the equipment affecting the boat safety during at least 8 hours, without recharging.

3.1.5 For motor boats operating in navigation areas **2** and **3,** as well as at daytime in navigation area **IV,** the use of one accumulator battery is permitted. The battery shall have sufficient capacity for ensuring 6 consecutive starts and supplying the equipment affecting the boat safety during at least 8 hours, without recharging.

3.1.6 The generator, installed on board, shall be capable of supplying all electrical equipment and simultaneously be capable of charging the accumulator batteries within a time not exceeding 8 hours.

3.1.7 Electric power balance and the capacity of starter batteries shall be made according to PN-W-89509.

3.1.8 The selection of starter batteries according to the engine manufacturer's recommendations is permissible. Above mentioned should be documented.

3.1.9 Where more than one starter is supplied from the same accumulator battery, the battery capacity shall be not less than the sum of the capacity calculated for the starter with the highest power output and 50% of the capacity calculated for each additional starter.

3.2 Electrical Power Parameters

3.2.1 During charging accumulator batteries or where the electric installation is supplied by accumulator batteries only, the permissible long-term deviation from the rated voltage shall not exceed +25% to -15%.

3.2.2 The length and cross-sectional area of conductors shall be such that the voltage drop, with every appliance in the circuit switched on at full load, does not exceed:

– 3 % in accumulator charging circuits and in circuits supplying the main switchboard, in navigation lights, navigation equipment and bilge pumps circuits;
– 7 % in power circuits, lighting circuits and the remaining circuits.

The method of selecting cable cross-sections is given in sub-chapter 13.2.

3.3 Electromagnetic Interference

3.3.1 Cables shall be so run and electrical equipment so installed as not to cause electromagnetic interference of radio and navigation equipment operation.

3.3.2 It is recommended that generating sets, isolation transformers, as well as voltage and frequency converters, installed on motor boats, should comply with the requirements of Directive 2014/30/UE relating to electromagnetic compatibility.

3.4 Electrical Power Sources Supplied at a Voltage Higher than Safe Voltage

3.4.1 Generating sets, voltage and frequency converters, as well as transformers shall be located at least 500 mm above the anticipated bilge water level.

3.4.2 Only dry-type transformers shall be used on motor boats.

3.4.3 An indicator shall be provided in an easily visible place on AC or the main switchboard control panel to indicate the operation state of all electrical power sources supplied at a voltage higher than safe voltage.

3.4.4 Voltage and frequency converters shall ensure electric isolation between AC and DC systems.

4 ACCUMULATOR BATTERIES

4.1 General Requirements

4.1.1 It is recommended that non-service accumulator batteries (valves regulated) should be used.

4.1.2 It is recommended that service accumulator batteries should be traction batteries (deep-discharge batteries), marked “marine.

4.2 Installation Requirements

4.2.1 A battery isolation switch shall be installed in the positive conductor of the battery/group of batteries, connected to the supply system voltage in a readily accessible location, as close as practicable to the battery/group of batteries. For DC distribution systems where both positive and negative conductors are isolated from earth, double pole isolation switches shall be used.

This requirement does not apply to outboard-powered boats with circuits for engine starting and navigation lights only.

4.2.2 The minimum continuous rating of the battery/group of batteries isolation switches shall be not less than the full-load current and operating voltage of the circuit. The rating of isolation switches, through which the voltage is supplied to the starter, shall be suitable for momentary starting current.

4.2.3 The following systems, individually protected by a fuse or circuit-breaker, may be connected between the isolation switch and the battery:
- bilge pumps;
- engine alarm and monitoring signal;
- exhaust ventilation from engine and fuel tank compartments, as well as accumulator batteries compartment;
- instruments monitoring batteries charge;
- other appliances subject to PRS’ acceptance in each particular case.

4.2.4 The following conductors are allowed to be connected to the battery/group of batteries terminals:
- main supply conductors;
- the rectifier or other charging devices conductors;
- conductors connecting batteries into a group of batteries;
- conductors supplying the equipment listed in 4.2.3.

4.2.5 The battery connection and charging system shall preclude the batteries from being discharged due to charging device voltage drop or decay. It is recommended that diode separation or VSR relay should be used between starter batteries and service batteries, as well as other accumulator batteries.

4.2.6 The motor boat battery/batteries charging system shall ensure continuous charging of all batteries during propulsion engine operation.

4.2.7 Battery charging devices shall be appropriately selected and adjusted to the type and capacity of the installed batteries.

4.2.8 Where isolation switch is placed in accumulator batteries box or inside the accumulator batteries compartment, it shall be of explosion-proof construction.

4.2.9 Accumulator batteries shall not be used for supplying consumers operating at a rated voltage lower than the total voltage of all cells of the batteries.

4.2.10 Where the propulsion engine starting system is designed for a voltage higher than the rated voltage of the motor boat’s electrical installation, a short-time connection of batteries in series for the purpose of starting the engine is permitted. Suitable change-over switches shall be used for the connection of batteries.

4.2.11 Accumulator batteries, except batteries intended for starting internal combustion engine, shall be protected against short-circuits by fuses located as close as practicable to batteries terminals, but outside the battery container/box.

4.2.12 In starter batteries circuits, short-circuit and overload protection shall not be used.

4.2.13 It is recommended that charging devices should be fitted with instruments for monitoring charging of batteries.

4.3 Arrangement of Accumulator Batteries

4.3.1 Accumulator batteries shall be installed above the anticipated bilge water level, in a dry, easily accessible, ventilated location, not exposed to the effect of external factors, such as unacceptably high or low temperature, water spray and mechanical damage. The batteries shall be so located that escaping gases or electrolyte cannot constitute hazard.

4.3.2 The accumulator batteries shall be so arranged and installed as to allow to check their condition without the necessity to dismantle the structural parts of the motor boat.

4.3.3 Accumulator batteries shall be installed in such a manner that they will not move more than 10 mm in any direction when exposed to a force corresponding to twice the battery weight.

4.3.4 Lead-acid batteries and alkaline batteries shall not be placed in the same box or compartment. The containers and instruments intended for the batteries with different electrolytes shall be placed separately.

4.3.5 The inside part of the battery compartment or box, as well as structural parts which may be subjected to harmful effect of electrolyte or gas shall be made of appropriate material or shall be suitably protected.

4.3.6 Accumulator batteries shall be installed and protected so that metallic objects cannot come into unintentional contact with any battery terminal.

4.3.7 Terminals of accumulator battery cable shall not depend on spring tension for mechanical connection to them and they shall not be subjected to mechanical strain.

4.3.8 Terminals of accumulator batteries which are not located in boxes or separate compartments shall be covered with a protective cover made of dielectric material.

4.3.9 Accumulator batteries shall not be installed directly below rectifiers or converters, above and below fuel tanks, fuel filters and any other metallic components of the fuel system.

4.3.10 Starter batteries shall be located as close as possible to the propulsion engine.

4.3.11 Accumulator batteries shall not be installed in the same compartment in which petrol engines, petrol cylinders or gas cylinders are located. This requirement does not apply to accumulator batteries with valves (closed), including gel batteries.

4.3.12 It is recommended that batteries/group of batteries having a capacity of up to 2 kW, calculated from the 8 hour charging current and rated voltage, should be located in naturally ventilated boxes or lockers inside the motor boat hull, in well-ventilated spaces, except accommodation spaces.

4.3.13 Where, owing to the distance to main consumers, accumulator batteries are placed in accommodation area, they shall be placed in closed containers, boxes or separated lockers fitted with ventilation ducts led to the open deck.

4.3.14 Batteries/group of batteries having a capacity of over 2 kW, calculated from the 8 hour charging current and rated voltage, shall be located in closed boxes or separate compartments fitted with ventilation system complying with the relevant requirements specified in *Part VI – Machinery and Piping Systems* of the *Rules for the Classification and Construction of Small Sea-going Ships.*

4.3.15 Accumulator batteries ventilation system shall not be common with other ventilation systems.

5 INVERTERS AND CHARGERS

5.1 Permanently installed inverters and inverter/chargers shall supplying less than 250V at a frequency of 50 Hz or 60 Hz, and shall
- be designed to operate up to an ambient temperature of 50 °C and withstand an ambient temperature of 70 °C without damage;
- be automatically controlled;
- provide isolation of the AC output from the DC supply circuit;
- have controls which are readily accessible;
- be located in a ventilated, dry, readily accessible site where ambient temperatures will not exceed 50 °C;
- be mounted away from heat sources such as engine exhaust system components and other heat-producing devices;
- be mounted not less than 500 mm above foreseeable levels of bilge water.

5.2 Inverter outlet circuits shall be protected in accordance with chapter 12.

6 DISTRIBUTION OF ELECTRICAL POWER

6.1 General Requirements

6.1.1 In motor boats fitted with both DC and AC electrical systems, these systems shall be clearly separated.

6.1.2 The cables of the DC and AC electrical systems shall be installed on separate trays. When single conductors are installed, the DC and AC conductors shall be separated by at least 100 mm.

6.1.3 The DC and AC electrical systems shall be supplied from separate switchboards. A common switchboard may be permitted if a partition or other positive means is provided to separate clearly the DC and AC sections from each other.

6.1.4 After removal of the switchboard casing and panels, the terminals shall be accessible and marked in such a way at to allow easy identification of the circuits.

6.1.5 The AC and DC conductors, as well as conductors operating at different voltages shall be not be connected to the same terminal block. The positive and negative pole terminal blocks shall be explicitly marked.

6.1.6 The protections of the lighting final circuits of spaces shall be designed for the rated current not exceeding 10 A. The cabin fans and other minor consumers may be supplied from the lighting final circuits.

6.2 DC Distribution Systems

6.2.1 The DC equipment shall function in accordance with the requirements of PN-EN ISO 10133 over a voltage range at the battery terminals as follows:
- for a 12 volt system: 9 V to 16 V;
- for a 24 volt system: 18 V to 32 V.

6.2.2 On DC installations, the following distribution systems may be used:
- two-wire insulated;
- two-wire with negative earth.

For motor boats having aluminium hulls, two-wire insulated system is recommended.

The motor boat's hull shall not be used as return conductor. In propulsion engine electric system, the engine block may be used as earthing conductor.

Systems with multiple battery banks shall have a common negative connection.

6.2.3 The cross-sectional area of negative pole conductor, connected to earthing plate or to the motor boat hull shall be the same as the cross-sectional area of the positive pole main conductor connecting an accumulator battery with a starter or the main switchboard, whichever is the greater.

6.2.4 The use of other distribution systems or other rated voltages will be specially considered by PRS.

6.3 AC Distribution Systems

6.3.1 The permissible rated voltage of 50 Hz across the terminals of the sources of electrical power shall not exceed:
– 230 V at the single-phase alternating current;
– 400 V at the three-phase alternating current.

6.3.2 On AC installations, the following distribution systems may be used:
– single-phase, two-wire insulated (IT);
– single-phase, three-wire with neutral insulated or directly earthed (TN-S);
– three-phase, three-wire insulated (IT);
– three-phase, five-wire with neutral earthed (TN-S).

On motor boats having aluminium hulls, it is recommended to use electrical installation fitted with isolation transformer or to install galvanic isolator in PE conductor.

In no of the above systems can the hull be used as return conductor. When an optional galvanic isolator is fitted in the protective conductor to resist imported stray galvanic current flow while permitting the passage of AC current, failure of the isolator shall not result in an open circuit.

6.3.3 The use of other distribution systems, as well as the values of the voltage and frequency shall be agreed with PRS.

6.3.4 Insulated distribution systems shall be provided with devices to monitor the insulation level to earth.

6.3.5 In earthed systems, in addition to excess current circuit breaker, a residual-current protective device with sensitivity of 30 mA shall be fitted in the main supply circuit to automatically disconnect the supply.

6.3.6 The motor boat AC system circuits shall not be capable of being energized by more than one source of electrical power at a time. Each shore power inlet, generator set or inverter shall be regarded as a separate source of electrical power.

6.3.7 The transfer from one power source circuit to another shall be made by a means which opens all current-carrying conductors, before closing the other source circuit.

6.3.8 The power sources change-over switch shall prevent electric arc between contacts and shall be interlocked by mechanical and electromechanical means.

6.4 Power Supply from an External Source of Electrical Power

6.4.1 Where provision has been made for the supply of the motor boat's network from an external source, a shore supply inlet shall be installed on the boat.

6.4.2 Shore power supply terminal shall be a „male' socket-outlet, protected against mechanical damage and flooding with water; the degree of enclosure protection shall be in accordance with 2.5.2, but not less than IP 44.

6.4.3 Shore power supply terminal permanently connected to the connection point on the yacht shall have the enclosure protection IP 56.

6.4.4 The inlet shall be installed in a place suitable for the connection of the flexible cable to the shore supply socket outlet and shall be provided with a plate stating the supply rated voltage, frequency and the permissible rated current.

6.4.5 The main circuit of power supply from an external source shall be protected against short circuits and overloads and shall be provided with voltage presence indicator at the main switchboard or other switchboard/panel.

6.4.6 The overcurrent protective device shall simultaneously open all current-carrying conductors. During power supply from the shore, the motor boat installation protective conductor shall be connected with PE of the shore system, except cases when the shore power is supplied through an isolation transformer so connected that complete isolation of the motor boat installation from the shore system is ensured.

6.4.7 The shore power supply signalling system should allow to check the polarity of the incoming supply in relation to the yacht's system. This does not apply to motor boats fitted with isolation transformers in which case the whole installation is equally polarized and when double-pole circuit breakers are installed.

6.4.8 For three-phase system, provision shall be made for checking the phase sequence of the incoming shore in relation to the motor boat's system.

6.4.9 The shore power shall be supplied by flexible external cable, having the cross-sectional area suitable for the prescribed power input and the length not exceeding 25 m. It is recommended that the cable should be made in accordance with PN-EN 60092-507.

6.5 Socket Outlets

6.5.1 Socket outlets installed in circuits with different voltages shall be so designed as to prevent insertion of a plug intended for one voltage into a socket intended for another voltage.

6.5.2 Socket outlets installed on open decks shall be suitably protected against mechanical damage and flooding with water, in accordance with 2.5.2.

6.5.3 Socket outlets in AC systems should be of the earthing type with a terminal provided for the protective conductor.

6.6 Switchboards

6.6.1 On motor boats fitted with AC and DC electrical systems, the switchboards shall comply with the requirements specified in 6.1.3 and 6.1.5.

6.6.2 The switchboard casings, brackets and connecting elements shall be made of metal or other fire-retardant material having low flame-spread characteristics.

6.6.3 The degree of switchboards enclosure protection shall depend on their location as specified in 2.5.2.

6.6.4 Switchboard shall be so installed as to allow easy reading of parameters and switchgear operation.

6.6.5 Switchboards shall be installed in such a way that controls, indicators, switches and fuses are readily accessible. Access to terminals shall be provided.

6.6.6 It is recommended that switchboards should be fitted with measuring instruments indicating the basic parameters of the electric power generating system, i.e. voltage and current, as well as monitoring the accumulator batteries charge, generating set load, the direction of electric power transfer from voltage converters. The rated values shall be indicated on the instruments scale.

6.6.7 Where measuring instruments are not available, charging (alternator operation) signal lamp and voltage drop alarm shall be installed.

6.6.8 For three-phase system, provision shall be made for checking the phase and monitoring the load of each phase.

6.6.9 Liquid-carrying pipes shall not be led above switchboards and consoles. Pipes may be led in front and at side of the switchboards and consoles, at a distance not less than 200 mm, provided that demountable joints are not installed there.

6.6.10 It is recommended that the main switchboard shall be provided with at least 2 auxiliary circuits for connecting additional electrical consumers, including protective devices.

6.6.11 Doors and other swing elements of switchboards shall be fitted with interlocking arrangements preventing them from being automatically closed when maintenance work is carried out during voyage.

7 ELECTRIC LIGHTING

7.1 General Requirements

7.1.1 It is recommended that, depending on the size and designation of the motor boat, the boat general lighting, the lighting of machinery spaces, as well as spaces in which people may be employed, should be separated into two circuits fitted with independent protective devices.

7.1.2 Lighting fixtures shall be installed in such a manner as to prevent the heating of cables and adjacent materials up to a temperature exceeding the permissible temperature.

7.1.3 It is recommended that on each lighting fixture, the rated voltage and the permissible luminance level of a light source should be durably indicated.

7.2 Navigation Lights

7.2.1 The arrangement of the motor boat navigation lights, depending on the boat's length, shall comply with the relevant requirements of the *International Regulations for Preventing Collisions At Sea – COLREG 1972* with respect to coastal boats and the requirements of *CEVNI Regulations* with respect to inland waterways boats.

7.2.2 Navigation lights shall be supplied from the main switchboard or from a separate navigation lights distribution board so located as to be visible by the helmsman.

7.2.3 Where navigation lights are so located that they cannot be seen by the helmsman, they shall be provided with visual indicators showing the operation of each navigation light.

7.2.4 Each navigation light shall be supplied by a separate circuit protected by a circuit-breaker. It is recommended that each navigation light shall be fitted with its own switch. However, it is permitted to use one switch for a group of navigation lights always operating simultaneously.

7.3 Emergency Escape Lighting

7.3.1 It is recommended that motor boats carrying passengers shall be provided with a fixed lighting of liferaft stowage and launching area.

7.3.2 In electric power balance prepared for emergency conditions, provision shall be made for accumulator battery reserve capacity ensuring the lighting of passageways and passenger spaces for 1 h.

8 POWER CONSUMERS

8.1 The lighting circuits shall not supply power and heating consumers. This requirement does not preclude the supply of low power consumption cabin fans and other consumers of current rating up to 2A from lighting circuits.

8.2 It is recommended that electric motors should be installed far from the bilges and in locations where they will not affect the operation of other equipment (the temperature of the engine housing, vibrations).

8.3 Unless specially designed, electric motors and other devices fitted with brushes, commutator or rings shall be installed outside spaces, in which flammable vapors may accumulate.

8.4 Provision shall be made for the local starting and stopping of each electric and hydraulic motor.

8.5 Provision shall be made for remote switching on and switching off ventilation fans and pumps from outside the engine compartment.

8.6 Electric bilge pumps shall comply with the requirements of the PN-EN ISO 8849 standard.

8.7 Fans installed on motor boats should meet the requirements of PN-EN ISO 9097.

8.8 It is recommended that windlasses, capstans and thrusters should be supplied by separate accumulator batteries.

9 ELECTRIC PROPOLUSION SYSTEMS

9.1 The installation of the unit's electric drive system will be individually considered by PRS for compliance with the requirements of the currently valid PN-EN ISO 16315 standard.

10 CONTROL AND AUTOMATION SYSTEMS

10.1 Each control and automatic system shall be so designed as to prevent the automatic restart of the controlled machinery after voltage decay or the machinery stopping by the safety system.

10.2 The simultaneous control of the main propulsion, auxiliary machinery and associated equipment, as well as steering of the motor boat shall be possible from one control station only.

10.3 Transfer of control from one station to another shall be possible only after it has been accepted by the station taking over the control.

10.4 Manual local control shall be independent of automatic or remote control.

11 ALARM SIGNALS

11.1 General Alarm System

11.1.1 Motor boats in which an alarm given by a human voice or by any other means will not be heard simultaneously in all locations where people may be present shall be fitted with general emergency alarm system that will ensure good signal audibility in all such spaces.

11.2 Other Signals

11.2.1 Visual and audible alarms shall be provided for:
- main propulsion operation;
- bilge water level.

Visual alarms shall be located within the helmsman’s eyesight on each control position.

11.2.2 Indicators of the main propulsion operation and power supply parameters shall be located within the helmsman’s eyesight on the main control position.

12 PROTECTIVE DEVICES

12.1 General Requirements

12.1.1 Protective devices shall be so matched with the characteristics of the equipment under protection and the equipment work as to operate at all inadmissible overloads.

12.1.2 Every circuit in the switchboard shall be protected, in at least the positive or phase conductor, against overcurrent and short-circuit by a fuse or a trip-free circuit breaker. The circuits of equipment or a group of equipment whose operation affects the safety of the motor boat and human life shall be individually protected.

12.1.3 A manually reset trip-free circuit breaker or a fuse shall be installed within 200 mm of the source of power for each circuit or conductor of the system, measured along the conductor.

If the conductor is connected directly to the battery terminal and is contained throughout its entire distance in a sheath or enclosure such as a conduit, junction box, control box or enclosed panel, the overcurrent protection shall be placed as close as practicable to the battery, but shall not exceed 1,8 m.

If the conductor is connected to a source of power other than a battery terminal and is contained throughout its entire distance in a sheath or enclosure such as a conduit, junction box, control box or enclosed panel, the overcurrent protection shall be placed as close as practicable to the point of connection to the source of power, but shall not exceed 1 m.

Those requirements do not include cranking motor conductors.

12.1.4 A manually reset trip-free circuit breaker shall be installed within 0,5 m of the source of power or, if impractical, the conductor from the source of power to the panel-board circuit breaker shall be contained within a protective covering, such as a junction box, control box, enclosed panel board or within conduit or cable trunk or equivalent protective covering.

12.1.5 If the location of the main shore power inlet circuit breaker exceeds 3 m from the shore power inlet connection or the electrical attachment point of a permanently installed shore power cord, additional circuit breakers shall be provided within 3 m of the inlet or attachment point to the electrical system in the craft, measured along the conductor.

12.1.6 The protection system shall be discriminative both with regard to overload currents and to the prospective short-circuit currents.

12.1.7 On motor boats having hulls made of conductive materials, fitted with insulated installation, the protective devices and switchgear, referred to in 12.1.2, shall be provided for both poles/all current-carrying conductors. In the case of the safety voltage installation, this requirement is applicable only to the main protective device and a switch.

12.1.8 For motor boats with hulls of non-conductive materials, fitted with insulated installation, the protective devices and switchgear, as specified in 12.1.7, is recommended.

12.1.9 It is recommended that all protected circuits shall be additionally fitted with switches.

12.1.10 In circuits in which separate protective devices and switches are fitted, the fuse shall be installed between the busbar (or power supply source) and a switch.

12.1.11 Short-circuit protective devices shall be set to operate at not less than 200 per cent of the rated current.

12.1.12 Overload protective devices shall be so selected that the value of the protective device operating current will not exceed 150 per cent of the overload specified in Table 13.2.1 for conductor cross-sectional area of the protected circuit.

12.1.13 The rated short-circuit breaking current of the protective devices shall be not lower than the anticipated short-circuit current at the place of their installation.

12.2 Protection of Power Consumers

12.2.1 For each electric motor rated at 0.5 kW and over, provision shall be made for a separate supply circuit protected against short-circuit and overload.

12.2.2 Each DC consumer rated at 1 kW and over shall be fitted with individual short-circuit and overload protection.

12.2.3 The overload protective devices for continuously loaded motors shall be set to disconnect the protected motor in a range of 105 and 125 per cent of the rated current.

12.2.4 It is recommended that the following equipment installed on board: thrusters, capstans and windlass/mooring winches should be provided with protective devices supplied by the equipment manufacturers. Otherwise, protection with time delay shall be installed.

12.3 Protection of Generators

12.3.1 Generators shall be provided with means of protection against short-circuits and overloads. Alternators may be fitted with built-in overload protection.

12.3.2 The overload protective device shall disconnect the generator (generating set) or an alternator at overload exceeding 120 per cent of the rated current.

12.4 Protection of transformers

12.4.1 Overcurrent protection shall be provided for isolation and polarization transformers, including a bank of transformers operating as a unit. Each transformer shall be protected by an individual overcurrent device on the primary side, rated at not more than 125 % of the rated primary current of the transformer.

12.5 Protection against Electric Shock in AC Systems

12.5.1 Where a risk of personal contact with live conductive parts may exist, a residual current protective devices shall be fitted to automatically disconnect the supply exceeding 50 V r.m.s in the event of a fault between a live part and an exposed non-current carrying conductive part and to provide protection against dangerous patophysiological effects from electric shock.

12.5.2 Circuits supplying socket outlets installed in camboose, toilet, the engine compartment or on the open deck shall be fitted with residual current protective devices with sensitivity not greater than 10 mA or a single RCD which will disconnect the supply. The RCD devices shall have an internal circuit for manual testing of the trip function.

12.5.3 For motor boats fitted with a single electrical equipment operating at a voltage exceeding 50 V, supplied from external source of electrical power only, it is recommended that in addition to the main short-circuit and overload protection, RCD device with a sensitivity of 30 mA disconnecting the supply should be installed.

13 CONDUCTORS

13.1 General Requirements

13.1.1 Conductors shall be multi-wire copper conductors, of flame-retardant type and having low flame-spread characteristics (e.g. polyvinyl chloride compound, cross-linked polyethylene compound, butyl rubber compound, ethylene-propylene rubber compound, silicone rubber compound) according to national or international standards agreed with PRS, with cross-sectional area not less than 1.5 mm^2 (0.75 mm^2 in control and signalling units).

13.2 Selection of Cables for Loads Required

13.2.1 Permissible continuous loads on single-core cables, with the minimum number of wires in the cable, at the ambient air temperature of +30°C, shall be taken in accordance with Table 13.2.1, depending on the maximum temperature of conductor.

Table 13.2.1

Nominal cross-sectional area of conductor [mm²]	Permissible continuous loads on single-core cables, in amperes				
	60°C	70°C	85 ÷ 90°C	105°C	125°C
0.75	6	10	12	16	20
1	8	14	18	20	25
1.5	12	18	21	25	30
2.5	17	25	30	35	40
4	22	35	40	45	50
6	29	45	50	60	70
10	40	65	70	90	100
16	54	90	100	130	150
25	71	120	140	170	185
35	87	160	185	210	225
50	105	210	230	270	300
70	135	265	285	330	360
95	165	310	330	390	410
120	190	360	400	450	480
150	220	380	430	475	520

NOTE: The permissible current capacity specified in Table 13.2.1 relates to an ambient temperature of + 30 ° C. In rooms where the expected ambient temperature is higher than + 30 ° C, cables intended for operation at elevated temperatures should be used. The permissible current-carrying capacity for cables and wires for different insulation temperature limits and different ambient temperatures are included in Publication No. 15/P.

13.2.2 Conductor insulation temperature ratings in engine spaces shall be 70° C minimum, and the conductor insulation shall be oil-resistant, or shall be protected by insulating conduit or sleeving.

13.2.3 For cables installed in the engine compartment (ambient temperature of +60 °C), correction factors shall be taken in accordance with the below Table.

Table 13.2.3

Maximum conductor temperature [°C]	Correction factors
70	0.75
85 ÷ 90	0.82
105	0.86
125	0.89

13.2.4 Where more than 6 cables installed in one bunch may be simultaneously loaded by the rated current, the values of the permissible current ratings for the relevant cross-sectional areas shall be reduced by 15% (factor 0.85 shall be applied).

13.2.5 Irrespective of conductor selection in accordance with Tables 13.2.1 and 13.2.3, the nominal cross-sectional area of conductor, *s*, depending on the permissible voltage drop, shall be not less than that calculated from the formula:

$$s = 2\,kPl, \quad [\text{mm}^2] \qquad (13.2.5)$$

k – factor of the permissible voltage drop, in accordance with Table 13.2.5,
P – the maximum carrying current in the circuit, [W];
l – the length of cable from the power supply to the power consumer, [m].

Table 13.2.5

Rated voltage	3% of voltage drop for battery charging circuits, supplying navigation lights, bilge blowers, bilge pumps, circuits supplying the main switchboard , and other vital to safety	7% of voltage drop for he remaining circuits
12 V	$4.0 \cdot 10^{-3}$	$1.71 \cdot 10^{-3}$
24 V	$1.0 \cdot 10^{-3}$	$0.43 \cdot 10^{-3}$

13.2.6 When selecting the conductors, account shall be taken of the equipment manufacturers' requirements. This applies, in particular, to the cross-section of the conductor supplying IC starter, which shall be in accordance with the engine manufacturer's requirements.

13.2.7 If, in technical documentation, the engine manufacturer does not specify the cross-section of the engine starter power supply conductors depending on the distance from starter accumulator batteries, the applied conductors shall comply with the requirements of PN-W-89509.

13.2.8 The cross-sectional areas of conductors supplying equipment operating under load for a short time: winches, capstans, thrusters, may be less than those given in Table 13.2.1.

13.2.9 Where not specified by the manufacturer, the conductors supplying:
– capstans and windlass/mooring winches shall be selected as for 60 min short-duty operation;
– thrusters shall be selected as for 30 min short-duty operation.

Permissible loads, according to Table 13.2.1, may be increased by correction factors given in Table 13.2.9.

Table 13.2.9

Conductor nominal cross-section [mm^2]	30 min operation	60 min operation
1 to 10	1.06	1.06
16	1.09	1.06
25	1.19	1.08
35	1.33	1.14
50	1.55	1.25
70	1.85	1.43

13.3 Installation of Cables

13.3.1 Conductor runs shall be, as far as possible, straight and shall pass through locations where they will not be exposed to the effect of fuel, oil, water and excessive heating. Conductor runs shall be installed not closer than 100 mm (250 mm from dry exhaust components) to the source of heat unless adequate thermal insulation has been provided.

13.3.2 Conductors installed in locations in which they may be exposed to mechanical damage shall be suitably protected.

13.3.3 Conductors not provided with short-circuit and overload protection shall be as short as practicable and shall be specially protected against mechanical damage to insulation which may cause short-circuit. Such protection will be ensured by metal armoured conductors or running the conductors in conduits.

In the safe voltage installations, the use of non-armoured conductors is permitted over short sections of conductor (e.g. connection of accumulator batteries, to the main switch) if they are insulated and sheathed.

13.3.4 The length of a cable connecting accumulator batteries with the main switchboard, starter, alternator shall be as short as practicable.

13.3.5 The cables shall be properly secured by means of holders, clamps and other similar elements made of metal or other non-combustible material or not-readily combustible material or shall be run in protective insulation pipes.

13.3.6 Conductors and cables shall be supported throughout their length in conduits, cable trunks or trays, or by individual supports at maximum intervals of 450 mm.

13.3.7 Cables shall not be directly laminated and inserted into a laminate.

13.3.8 Protective insulation or metal pipes, in which the cables are run, shall be so installed as to preclude condensation of water.

13.3.9 The cable holders shall be of adequate width, free of sharp edges and protected against corrosion. The holders shall be so selected that the cables are fastened in position securely but without damage to their protective coverings.

13.3.10 Cables shall be fastened in such a manner that mechanical strains in cables are not transmitted to their inlet connections.

13.3.11 When installing the cables through non-watertight bulkheads or elements of the yacht's structure not exceeding 6 mm in thickness, lining or bushings that will prevent damage to cables shall be provided.

13.3.12 Installation of cables under the flooring shall be avoided, except the cables supplying outboard equipment and end sections of cables supplying bilge pumps. It is recommended that cables should be installed in cable ducts and their machinery connections shall not reduce the enclosure protection degree of supplied machinery.

13.3.13 Penetration of watertight bulkheads and decks shall be made tight. Packing of cable penetrations through the bulkheads and decks shall be so made as to maintain their tightness.

13.3.14 Connection of cables at places of tapping shall be effected in junction boxes or covered strips by means of clamps.

13.3.15 All conductors shall have suitable terminals installed and be prepared for securing in clamps. At screw clamps cable terminals shall be applied. The friction-type connectors may be used in circuits not exceeding 20 A if the connection does not separate when subjected to a force of 20 N.

13.4 Survey of Electrical Installation

13.4.1 On motor boats fitted with AC electrical power sources other than shore power supply connection, the measurements of the effectiveness of protection against electric shock shall be carried out at every Class Renewal Survey.

13.4.2 The insulation resistance of circuits and equipment shall not be lower than the values given in Table 14.4.2.

Table 14.4.2

Item	Circuit designation:	Minimum insulation resistance, [MΩ]	
		Installation voltage up to 50V	Installation voltage up to 500V
1	Lighting, communication and signalling circuits	0.3	1.0
2	Power circuits	1.0	1.0

13.4.3 It is recommended that continuity of earthing and bonding conductors, as well as the effectiveness of cathodic protection should be periodically checked..

13.4.4 The earthing resistance shall not be greater than 1.0 Ω.

Annex 1

List of reference standards

Item	*Standard No.*	*Title*
1	PN-EN ISO 10133	Small craft – Electrical systems – extra low-voltage d.c. installations (*harmonized)*
2	PN-EN ISO 13297	Small craft – Electrical systems – alternating current installations (*harmonized)*
3	PN-EN 60092-507	Electrical installations in ships – Part 507: Small vessels (*harmonized)*
4	PN-EN ISO 8846	Small craft. Electrical devices. Protection against ignition of surrounding flammable gases (*harmonized)*
5	PN-W-89509	Statki taboru technicznego – Baterie akumulatorów – Dobór (Polish only)
6	ISO/TR 10134	Small craft – Electrical devices – Lighting protection systems
7	PN-EN ISO 9097	Small craft – Electric fans (*harmonized)*
8	PN-EN ISO 16315	Small craft – Electric propolusion systems (*harmonized)*
9	PN-EN ISO 8849	Small craft – Electrically operated direct-current bilge-pumps (*harmonized)*

harmonized standard – the harmonized standard under Directive 2013/53/EC

List of amendments effective on the 1 January 2021

Item	*Title/Subject*	*Source*
2.4.1, 3.3.2	Update of Directive No. to the newest one	PRS
2.6.1	Added optional IEC Standard	PN-EN ISO 13297-2018
3.1.1, 3.1.3, 3.1.5, 3.1.7, 3.1.8, 3.2.2, 6.3.2, 6.4.2, 6.5.3, 12.1.4, 12.1.5, 12.4, 13.3.1	Updated and added requirements	PN-EN ISO 13297-2018
3.2.2, 6.2.1, 6.2.2, 12.1.3, 13.2.1, 13.2.2, 13.2.5, 13.3.6	Updated requirements	PN-EN ISO 10133-2017
Chapter 5	Added chapter “Inverters and chargers”	PN-EN ISO 13297-2018
8.6-8.7, Chapter 9	Added requirements and chapter “Electric propulsion systems”	PN-EN ISO 9097 PN-EN ISO 16315 PN-EN ISO 8849