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Small craft — Electrical systems — Alternating current installations

Petits navires — Systèmes électriques — Installations à courant alternatif

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 13297 was prepared by Technical Committee ISO/TC 188, *Small craft*.

This third edition cancels and replaces the second edition (ISO 13297:2000), which has been technically revised.

Small craft — Electrical systems — Alternating current installations

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1 Scope

This International Standard specifies the requirements for the design, construction and installation of low-voltage alternating current electrical systems which operate at nominal voltages of less than 250 V single phase on small craft of hull length up to 24 m.

Additional information to be included in the owner's manual is listed in Annex B.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 8846, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases*

ISO 10133:2000[1)], *Small craft — Electrical systems — Extra low voltage d.c. installation*

ISO 10240, *Small craft — Owner's manual*

IEC 60079-0, *Explosive atmospheres — Part 0: General requirements*

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes — Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60446, *Basic and safety principles for man-machine interface marking and identification — Identification of conductors by colours or numerals*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
craft's earth
protective ground
connection, provided for safety purposes, that is established by a conducting connection with the common ground/earth (potential of the earth's surface)

1) Under revision.

3.2
equipotential bonding conductor
normally non-current-carrying conductor used to put various exposed conductive parts of direct current electrical devices and extraneous conductive parts at a substantially equal potential

3.3
residual current device
RCD
electro-mechanical switching device or association of devices designed to make, carry and break currents under normal service conditions and to cause the opening of contacts when the residual current attains a given value under specified conditions

NOTE RCDs serve to reduce the risk of injury to people from electrical shock hazard, and damage to equipment from leakage of stray currents to earth or to other circuits.

3.4
polarization transformer
transformer which automatically orientates the neutral and active (phase) conductors in the system in the same polarity orientation as the polarized system of the craft

3.5
isolation transformer
transformer with protective separation between the input and output windings and the protective conductor

3.6
neutral conductor
conductor connected to the neutral point of a system and capable of contributing to the transmission of electrical energy

3.7
protective conductor
protective grounding conductor
conductor, not normally carrying current, used for some measure of protection against electric shock, for electrically connecting any of the following parts of electrical equipment to the craft's ground (earth) and to the shore a.c. grounding conductor through the shore power cable:

a) exposed conductive parts of electrical equipment;

b) extraneous conductive parts;

c) the main grounding (earthing) terminal;

d) earth electrode(s);

e) the earth point of a source, or an artificial neutral

3.8
live conductor
conductor or conductive part intended to be energized in normal use, including a neutral conductor

3.9
active (phase) conductor
any conductor that is maintained at a difference of potential from the neutral or protective conductor

NOTE In a system that does not include a neutral or protective conductor, all conductors are to be considered active conductors.

3.10
ignition-protected equipment
equipment designed and constructed to give protection against ignition of surrounding flammable gases

NOTE See ISO 8846.

3.11
overcurrent protection device
device designed to interrupt the circuit when the current flow exceeds a predetermined value for a predetermined time

EXAMPLE A fuse or circuit breaker.

3.12
panel board
switchboard
assembly of devices for the purpose of controlling and/or distributing electrical power

NOTE Examples of devices include circuit breakers, fuses, switches, instruments and indicators.

3.13
polarized system
system in which the live conductors are connected in the same relation to all terminals on devices or receptacles (socket outlets) in a circuit

3.14
shore power appliance inlet
fitting designed for mounting on a craft, of a shrouded male type, to connect to the female connector on the craft end of the shore power cable in order to make the electrical connection for transmission of electrical energy

3.15
trip-free circuit breaker
mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of overload or short circuit, and which is designed so that the resetting means cannot be manually held in place to override the current-interrupting mechanism

3.16
accessible
capable of being reached for inspection, removal or maintenance without removing the craft's permanent structure

3.17
readily accessible
capable of being reached quickly and safely for effective use without the use of tools

3.18
sheath
uniform and continuous protective tubular covering of metallic or non-metallic material around one or more insulated conductors

NOTE Examples of appropriate materials include moulded rubber, moulded plastic, woven sleeving or flexible tubing.

3.19
conduit
part of a closed wiring system of circular or non-circular cross-section for insulated conductors and/or cables in electrical installations, allowing them to be drawn in and/or replaced

3.20
cable trunking
system of closed enclosures comprising a base with a removable cover intended for the complete surrounding of insulated conductors, cables, cords and for the accommodation of other electrical equipment

3.21
double-pole circuit breaker
device intended to interrupt both the neutral and active (phase) conductors in a circuit simultaneously when a designated current is exceeded for a predetermined time

3.22
captive spade terminal
conductor terminal component which is maintained in the connection to the screw or stud even when the threaded terminal fastener is loose

3.23
exposed conductive part
conductive part of electrical equipment, which can be readily touched and which is not normally live, but which can become live under fault conditions

3.24
fuse
protective device that interrupts the circuit irreversibly when the current flow reaches a specified value for a specific time

[SOURCE: ISO 8820-1:2008, 3.1]

3.25
galvanic isolator
device which can be installed in series with the a.c. protective conductor of the shore power cable to block low voltage d.c. galvanic current flow, but permit the passage of a.c. normally associated with the protective conductor

3.26
inverter
device powered by batteries, designed primarily to provide a.c. at a required voltage and frequency

3.27
inverter/charger
device designed to supply either a.c. power to a craft's electrical system or to utilize the craft's a.c. electrical distribution system to charge or maintain a battery or batteries supplying d.c.

3.28
extraneous conductive part
conductive part liable to introduce a potential, generally earth potential, and not forming part of the electrical installation

4 General requirements

4.1 The protective conductor insulation shall be green or green with a yellow stripe. Neither colour shall be used for current-carrying conductors.

NOTE The equipotential bonding conductor of the d.c. electrical system (see ISO 10133) also uses green or green with a yellow stripe insulation and is connected to various exposed conductive parts of d.c. electrical devices, other extraneous conductive parts and the d.c. negative ground/earth.

4.2 For crafts having a fully insulated d.c. system in accordance with ISO 10133, the a.c. protective conductor shall be connected to:

a) the hull of a metallic hulled craft;

b) for non-conductive hulls, the craft's external ground/earth or ground plate.

4.3 The hull of a metallic hull craft shall not be used as a circuit conductor.

4.4 The a.c. protective conductor(s) shall be provided with a final (single) connection to the hull of a metallic hull craft, or if the craft has a non-metallic hull, to the main grounding/earthing point of the craft.

4.5 On metallic hulls, the point of connection of the protective conductor shall be located above any anticipated water accumulation.

4.6 Metallic housings or enclosures of permanently installed a.c. electrical appliances shall be connected to the protective conductor system in the craft.

4.7 Individual circuits shall not be capable of being energized by more than one source of electrical power at a time. Each shore power inlet, generator or inverter is a separate source of electrical power. The transfer from one power source circuit to another shall be made by a means which opens all current-carrying conductors, active (phase) and neutral, before closing the alternate source circuit, to prevent arc-over between contacts, and should be interlocked by mechanical or electromechanical means. The conductors of both circuits-carrying conductors, active (phase) and neutral, shall be broken simultaneously when changing power sources.

The requirements for overcurrent protection and sizing of the switch are found in Clause 7. A combination of power sources can be used provided that:

— the device is constructed and tested to an applicable recognized standard;

  — the device includes anti-islanding protection;

  — the device includes personnel protection against backfeeding; and

— the installation is performed according to the manufacturer's instructions.

4.8 Energized parts of electrical equipment shall be guarded against accidental contact by the use of enclosures of at least IEC 60529-IP 2X or other protective means which shall not be used for non-electrical equipment. Access to energized parts of the electrical system shall require the use of hand tools or be at least IP 2X, unless otherwise specified. A suitable warning sign shall be displayed (see 5.2).

4.9 The neutral conductor shall be grounded (earthed) only at the source of power, i.e. at the onboard generator, the secondary of the isolation or polarization transformer, the shore power connection or inverter. The shore power neutral shall be grounded (earthed) through the shore power cable and shall not be grounded (earthed) on board the craft or:

a) for systems using an isolation transformer or polarization transformer, both the generator or inverter neutral and the transformer secondary neutrals may be grounded at the a.c. main grounding bus instead of at the generator, inverter, or transformer secondaries;

b) for systems using an isolation transformer or polarization transformer, or no shore power provision, both the generator or inverter neutral and the transformer secondary neutrals may be ungrounded provided double-pole protection and switching is installed.

4.10 When an optional galvanic isolator is fitted in the protective conductor to resist imported stray galvanic current flow while permitting the passage of a.c. current, failure of the isolator shall not result in an open circuit.

4.11 Reverse polarity indicating devices providing a continuous visible or audible signal shall be installed in shore power systems and shall respond to the reversal of the active (phase) and the neutral conductors, if the polarity of the system must be maintained for the proper operation of the electrical devices in the system. Otherwise, a branch circuit shall be provided with overcurrent protection in only the active (phase) conductors. This does not apply for the systems indicated below in a) and b).

Reverse polarity indicating devices are not required on craft employing:

a) unpolarized systems using double-pole branch circuit protection;

b) polarization or isolation transformers that establish polarity on the craft.

NOTE 1 Reverse polarity indicating devices might not respond to reversals of a live conductor and the protective conductor.

NOTE 2 Reverse polarity indicating devices respond to the reversal of an active (phase) conductor or grounded conductor only when there is continuity of the protective conductor to shore.

4.12 Craft equipped with both d.c and a.c. electrical systems shall have their distribution from either separate panel boards or from a common one with a partition or other positive means provided to separate clearly the a.c. and d.c. sections from each other, and shall be clearly identified. Wiring diagrams to identify circuits, components and conductors shall be included with the craft.

NOTE After completing an a.c. installation it is recommended to perform a system test according to Annex C.

5 Marking

5.1 Shore power inlets shall be marked to indicate voltage and current; they shall also be marked with the electricity warning symbol (ISO 7010 – W012) and the "refer to instruction manual/booklet" symbol (ISO 7010 – M002).

5.2 A permanently mounted waterproof warning sign shall be located at the panel board on the craft. The sign shall include the information shown in Figure 1a) or 1b).

General warning sign ISO 7010 – W001

Warning; Electricity ISO 7010 – W012

Warning; Flammable material ISO 7010 – W021

Refer to instruction manual/booklet ISO 7010 – M002

a) Suggested warning sign using symbols

WARNING — To minimize shock and fire hazards:	
1	**Turn off craft's shore power connection switch before connecting or disconnecting shore power cable.**
2	**Connect shore power cable to craft's inlet before connecting to shore power source.**
3	**If incorrect polarity is indicated, immediately disconnect cable.**
4	**Disconnect shore power cable at shore power source first.**
5	**Close shore power inlet cover tightly.**
DO NOT ALTER SHORE POWER CABLE CONNECTORS	

NOTE 1 Item 3 is required only if a polarity indicator is installed in the system.

NOTE 2 Items 2, 4 and 5 are not required for permanently connected shore power cable installations.

b) Suggested warning sign with text in language appropriate to the country of use

Figure 1 — Suggested warning signs

5.3 Switches and controls shall be marked to indicate their function, unless the purpose of the switch is obvious and if operation of the switch could not, under normal operating conditions, cause a hazardous condition.

5.4 Electrical equipment shall be marked or identified to indicate:

a) manufacturer's identification;

b) model number or designation;

c) electrical rating in volts and amperes or volts and watts;

d) phase and frequency, if applicable;

e) ignition protected, if applicable, by ISO 8846.

6 Ignition sources

Electrical components installed in compartments which in normal operation can contain LPG gases or petrol vapor, e.g. petrol tank, engine compartment and LPG lockers, shall be designed to be compliant with ISO 8846 or designed according to IEC 60079-0.

NOTE ISO 10088 requires that all components in petrol engines, petrol and LPG tank compartments be ignition-protected to prevent open sparks. This applies to the entire engine, as well as all electrical contacts, commutators, brushes, collector rings, switches, relays, generators, fuses, distributors, engine-cranking motors, propulsion trim motors, etc. ISO 8846 requires components to withstand any operating conditions of the device, including the maximum achievable overload up to 400 % of the rated current (circuit-breakers, switches and the like) and a stalled rotor condition for any motor with the circuit protected in an overcurrent protective device specified by the product manufacturer.

7 Overcurrent protection

7.1 General

7.1.1 In unpolarized systems double-pole circuit breakers opening both active (phase) and neutral conductors are required.

7.1.2 Fuses shall not be installed in unpolarized systems. If used in polarized systems, fuses shall be located to interrupt the active (phase) conductor.

7.1.3 Overcurrent protection devices for motor loads shall have a predetermined value of amperage consistent with electrical demand of the protected circuit.

7.1.4 All a.c. motor installations and each motor of a motor-operated device shall be individually protected in accordance with 7.1.3 or by an integral overcurrent or thermal protection device unless the motors will not overheat under continuous locked rotor conditions.

7.1.5 The rating of the overcurrent protection device shall not exceed the maximum current-carrying capacity of the conductor being protected. See Table A.1.

7.2 Supply circuits

7.2.1 Double-pole circuit breakers shall be installed in conductors to all supply circuits.

7.2.2 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 trunking or equivalent protective covering. 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.

7.2.3 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.

7.3 Branch circuits

7.3.1 The active (phase) conductor of each branch circuit in a polarized system shall be provided with overcurrent protection, i.e. fuse or circuit breaker, at the point of connection to the main panel board bus.

7.3.2 Both current-carrying conductors of each branch circuit in unpolarized systems shall be provided with overcurrent protection by double-pole circuit breakers and double-pole switches, at the point of connection to the main panel board bus.

NOTE Use of a reverse polarity indicator presumes compliance with 7.3.1.

8 Ground-fault protection/earth-leakage protection

8.1 RCDs shall be of the trip-free type.

8.2 The craft shall be provided with earth-leakage protection in all a.c. sources by one or more double-pole RCDs having a maximum nominal trip sensitivity of 30 mA and 100 ms maximum trip time.

NOTE Common standards for RCD construction are IEC 60898-2[10], IEC 61009-1[12] and IEC 61543[13].

8.3 The RCD device shall have an internal circuit for manually testing the trip function.

9 Appliances and equipment

9.1 Appliances and fixed a.c. electrical equipment installed on a craft shall have exposed conductive parts connected to the craft protective conductor, unless the appliance is of double-insulated construction.

9.2 Integral or external overcurrent protection shall be provided.

10 System wiring

10.1 Conductors shall have a minimum rating of 300/500 V. Flexible cords shall have a minimum rating of 300/500 V.

10.2 Conductors and flexible cords shall be multi-strand copper, with cross-sectional areas no smaller than those determined using Table A.1.

NOTE A conductor used for equipment grounding is not considered a current-carrying conductor when referencing Table A.1.

10.3 The insulation temperature rating of conductors and flexible cords outside engine spaces shall be at least 60 °C.

10.4 Conductors shall be at least 1 mm^2 in area. An exception can be made for conductors of minimum 0,75 mm^2 area which can be used as internal wiring in panel boards.

10.5 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. The conductors shall be derated in an allowable current-carrying capacity in accordance with Annex A.