INTERNATIONAL STANDARD

ISO 13297

Second edition
2000-12-01

Small craft — Electrical systems — Alternating current installations

Petits navires — Systèmes électriques — Installations de distribution de courant alternatif

Reference number
ISO 13297:2000(E)

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition (ISO 13297:1995), of which it constitutes a technical revision.

Annex A and B form a normative part of this International Standard. Annexes C and D are for information only.

Introduction

Annex A specifies conductor requirements. Annex B specifies instructions to be included with the owner's manual (ISO 10240). Annex C provides information on recommended system tests to be performed upon completion of the a.c. installation.

Compliance with this International Standard will not, by itself, provide protection against explosion, fire and electrical shock hazard. The manufacturer also needs to comply with additional standards related to protection against the same possible hazards. These additional standards are listed in annex D, with a brief description of their contents. For complete understanding of the requirements, the manufacturer needs to refer to the actual standard. Compliance with all these International Standards will ensure a high level of safety in all craft, particularly in those using petrol or liquefied petroleum (LPG).

Small craft — Electrical systems — Alternating current installations

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.

NOTE This International Standard does not cover three-phase installations.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8846:1990, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases*.

ISO 9094-1:—[1)], *Small craft — Fire protection — Part 1: Craft with a hull length of up to and including 15 m*.

ISO 10133:2000, *Small craft — Electrical systems — Extra-low-voltage d.c. installations*.

ISO 10240:1995, *Small craft — Owner's manual*.

IEC 60079-0:1998, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements*.

IEC 60446:1999, *Basic and safety principles for non-machine interface marking and identification — Identification of conductors by colours or numerals*.

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

IEC 60947-7-1:1989, *Low-voltage switchgear and controlgear — Part 7: Ancillary equipment — Section One: Terminal blocks for copper conductors*.

3 Terms and definitions

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

1) To be published.

3.1
craft's ground
craft's earth
ground (earth) which is established by a conducting connection (intended or accidental) with the common ground (potential of the earth's surface), including any conductive part of the wetted surface of the hull

3.2
residual (differential) current device
ground-fault circuit interrupter
RCD
GFCI
electromechanical 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 RCD/GFCI serve to reduce the risk of injury to people from electrical shock.

3.3
polarization transformer
transformer which automatically orientates the neutral and live conductors in the system in the same polarity orientation as the polarized system of the craft

3.4
isolation transformer
transformer with protective separation between the input and output windings and the protective conductor

3.5
neutral conductor
conductor connected to the neutral point of a system and capable of contributing to the transmission of electrical energy

3.6
protective earthing 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.

3.7
live conductor
conductor or conductive part intended to be energized in normal use, including a neutral conductor

3.8
ignition-protected equipment
equipment designed and constructed to comply with ISO 8846

3.9
overcurrent protection device
device, such as a fuse or circuit-breaker, designed to interrupt the circuit when the current flow exceeds a predetermined value for a predetermined time

3.10
panel-board
switchboard
assembly of devices for the purpose of controlling and/or distributing electrical power

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

3.11
polarized system
system in which the neutral and live conductors are connected in the same manner to all terminals on devices or receptacles (socket outlets) in a circuit

3.12
shore-power 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

3.13
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 are designed so that the resetting means cannot be manually held in place to override the current-interrupting mechanism

3.14
accessible
capable of being reached for inspection, removal or maintainance without removal of the permanent structure of the craft

3.15
readily accessible
capable of being reached quickly and safely for effective use without the use of tools

3.16
sheath
uniform and continuous protective tubular covering of metallic or non-metallic material around one or more insulated conductors

EXAMPLES Moulded rubber, moulded plastic, woven sleeving or flexible tubing.

3.17
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

3.18
cable trunking
system of closed enclosures comprising a base with a removable cover intended for the complete surrounding of insulated conductors, cables or cords and for the accommodation of other electrical equipment

3.19
double-pole circuit-breaker
device intended to interrupt both the neutral and live conductors in a circuit simultaneously when a designated current is exceeded for a predetermined time

3.20
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

3.21
exposed conductive part
conductive part of electrical equipment, which can be readily touched and which is not normally live, but which may become live under fault conditions

3.22
fuse
device that, by fusing of one or more of its specifically designed and proportioned components, opens a circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time

NOTE The fuse comprises all the parts that form the complete device.

3.23
galvanic isolator
device 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 alternating current normally associated with the protective conductor

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 direct-current electrical devices, other extraneous conductive parts and the d.c. negative ground/earth.

4.2 The protective conductor shall be connected to the craft's d.c. negative ground (earth) as close as practicable to the battery (d.c.) negative terminal.

NOTE If an RCD (whole-craft residual current device) or an isolation transformer is installed in the main supply circuit of the a.c. system (see 8.2), the negative ground terminal of the d.c. system need not be connected to the a.c. shore ground (protective conductor).

4.3 For craft with fully insulated d.c. systems (see ISO 10133), the a.c. protective conductor shall be connected to the hull of a metallic hull craft, the craft external ground (earth) or the craft lightning-protection ground plate, if fitted.

4.4 Metallic craft hulls shall not be used as conductors.

4.5 The protective conductor shall be connected to metallic hulls at a location above any anticipated water accumulation.

4.6 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, live and neutral, before closing the other source circuit, prevents arc-over between contacts and is interlocked by mechanical or electromechanical means. Both current-carrying conductors, live and neutral, shall be broken simultaneously when changing power sources.

4.7 Energized parts of electrical equipment shall be guarded against accidental contact by the use of enclosures of at least IP 2X type, in accordance with IEC 60529, 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 have a protection of at least IP 2X, unless otherwise specified. A suitable warning sign shall be displayed (see 5.2).

4.8 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, or the shore-power connection. The shore-power neutral shall be grounded through the shore-power cable and shall not be grounded on board the craft.

4.9 A galvanic isolator or other suitable device may be fitted in the protective conductor to resist imported stray galvanic current flow while permitting the passage of a.c. current, if present. Galvanic isolators shall be designed to withstand the application of power from a short-circuit test from a source capable of delivering 5 000 A r.m.s. symmetrically to its output test terminals for the time required for the circuit-breaker in the test circuit to trip. After three applications of the short-circuit test, the electrical and mechanical characteristics of the isolator shall be unchanged.

5 Marking

5.1 Shore-power inlets shall be marked to indicate voltage, current, shock hazard symbol  and read owner's manual symbol  .

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).

Warning | Electrical shock hazard | Fire hazard | Read owner's manual

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 polarity indicator is activated, 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.

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

Figure 1 — Suggested warning signs

NOTE In Figure 1 b), item 3 is required only if a polarity indicator is installed in the system and items 2, 4 and 5 are not required for permanently connected shore-power cable installations.

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, may contain liquefied petroleum gases (LPG) or petrol vapour, e.g. petrol tank, engine compartment and LPG lockers, shall be designed to be compliant with ISO 8846 or in accordance with IEC 60079-0, and shall be located in accordance with ISO 9094-1.

7 Overcurrent protection

7.1 General requirements

7.1.1 In unpolarized systems, double-pole circuit-breakers that open both live and neutral conductors are required.

7.1.2 Fuses shall not be installed in unpolarized systems.

7.1.3 Overcurrent protection devices for motor loads shall have a predetermined value of current flow that is consistent with demand-load characteristics 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 by an integral overcurrent or thermal protection device.

An exception may be made for motors that 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 Main supply circuits

7.2.1 Double-pole circuit-breakers shall be installed in conductors to the shore-power 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 a 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 fuses or 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 live conductor of each branch-circuit in a polarized system shall be provided with overcurrent protection, i.e. a fuse or circuit-breaker, at the point of connection to the main panel-board bus.

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

8 Ground-fault protection/earth-leakage protection

8.1 GFCIs (RCDs) shall be of the trip-free type.

8.2 The craft shall be provided with earth-leakage protection in the main supply circuit by

a) a double-pole RCD having a maximum nominal trip sensitivity of 30 mA and 100 ms maximum trip time located in accordance with 7.2.2, or

b) each receptacle located in the galley, toilet, machinery space or weather deck shall be protected by a GFCI (RCD) having a maximum sensitivity of 10 mA.

8.3 The GFCI (RCD) device shall have an internal circuit for manual testing of the trip function.

NOTE GFCI (RCD) double-pole receptacle (socket) devices may be installed as part of a convenient outlet installation, either in single-outlet applications or in multiple "feed through" installations, i.e. a series of receptacle (socket) outlets connected in parallel such that the first GFCI (RCD) protects everything in the circuit.

9 Appliances and equipment

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

Integral 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 300/300 V.

10.2 Conductors and flexible cords shall be of multistrand copper, and of sizes no smaller than those determined by reference to Table A.1.

NOTE A conductor used for equipment grounding is not considered to be a current-carrying conductor when making reference to 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 may be made for conductors of minimum 0,75 mm^2 area which may be used as internal wiring in panel-boards.

10.5 Temperature ratings of conductor insulation in engine spaces shall be 70 °C minimum. The conductors shall be rated oil-resistant, or shall be protected by an insulating conduit or sleeving, and shall be derated in allowable current-carrying capacity in accordance with annex A.

10.6 The protective conductor shall not have a cross-sectional area less than that of the live conductor in the supply circuit.

10.7 Live, neutral and protective conductors of the a.c. system shall be identified. Identification may be made by the insulation colour, by numbering or other means, if a wiring diagram for the system indicating the means of identification is supplied with the craft.

Insulation colours used, in conformance with IEC 60446:

— live conductors: black or brown;

— neutral conductors: white or light blue;

— protective conductors: green or green with a yellow stripe (see 4.1).

NOTE A colour stripe may be added to live and neutral conductor insulation for identification in the system.

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

11 Installation

11.1 Conductor connections shall be in locations protected from the weather or in IP 55 enclosures, in accordance with IEC 60529, as a minimum. Connections above deck exposed to intermittent immersion shall be in IP 67 enclosures, in accordance with IEC 60529, as a minimum.

11.2 Conductors shall be supported throughout their length in conduits, cable trunking or trays, or by individual supports at maximum intervals of 450 mm.

11.3 An a.c. circuit shall not be contained in the same wiring system as a d.c. circuit, unless one of the following methods of separation is used.

a) For a multicore cable or cord, the cores of the a.c. circuit are separated from the cores of the d.c. circuit by an earthed metal screen of equivalent current-carrying capacity to that of the largest core of the a.c. circuit.

b) The cables are insulated for their system voltage and installed in a separate compartment of a cable ducting or trunking system.

c) The cables are installed on a tray or ladder where physical separation is provided by a partition.

d) A separate conduit, sheathing or trunking system is used.

e) The a.c and d.c. conductors are fixed directly to a surface and separated by at least 100 mm.

11.4 Current-carrying conductors of the a.c. system shall be routed above forseeable levels of bilge water and in other areas where water may accumulate, or at least 25 mm above the water level at which the automatic bilge-pump switch activates.

If conductors must be routed in the bilge area, the wiring and connections shall be in IP 67 enclosures, in accordance with IEC 60529, such as continuous conduit, as a minimum, and there shall be no connections below the forseeable water level.

11.5 Metals used for terminal studs, nuts and washers shall be corrosion-resistant and galvanically compatible with the conductor and terminal. Aluminium and unplated steel shall not be used for studs, nuts or washers in electrical circuits.

11.6 Solderless crimp-on terminals and connectors shall be attached with the type of crimping tool designed for the termination used and for producing a connection meeting the requirements of 11.13.

11.7 All conductors shall have suitable terminals installed, i.e. no bare wires attached to stud or screw connections.

11.8 Screw-clamp or screwless terminals shall conform to IEC 60947-7-1. Other terminals shall be of the ring or captive-spade type, not dependent on screw or nut tightness alone for retention on the screw or stud. Captive-spade terminals shall be of the self-locking type.

An exception is that 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.

11.9 Twist-on connectors (wire nuts) shall not be used.

11.10 Exposed shanks of terminals shall be protected against accidental shorting by the use of insulating barriers or sleeves, except those in the protective conductor system.

11.11 Conductors shall be routed away from exhaust pipes and other heat sources which can damage the insulation. The minimum clearance is 50 mm from water-cooled exhaust components, and 250 mm from dry exhaust components, unless an equivalent thermal barrier is provided.

11.12 Conductors which may be exposed to physical damage shall be protected by sheaths, conduits or other equivalent means. Conductors passing through bulkheads or structural members shall be protected against insulation damage by chafing.

11.13 Each conductor-to-connector and conductor-to-terminal connection shall be capable of withstanding a tensile force equal to at least the value shown in Table 1 for the smallest conductor in the connection for 1 min, without separating.

Table 1 — Tensile values for connectors

Conductor size	Tensile force	Conductor size	Tensile force	Conductor size	Tensile force
mm^2	N	mm^2	N	mm^2	N
0,75	40	6	200	50	400
1	60	10	220	70	440
1,5	130	16	260	95	550
2,5	150	25	310	120	660
4	170	35	350	150	770

11.14 No more than four conductors shall be secured to one terminal stud.

12 Panel-boards (switchboards)

12.1 An a.c. system panel-board with a lamp indicating the system on/off function shall be installed.

12.2 A system voltmeter shall be installed on the panel-board if the system is designed to supply motor circuits or if an on-board generator is installed.

12.3 Panel-boards shall be permanently marked with the system voltage.

EXAMPLE 230 V a.c. or 230 V, 50 Hz.

12.4 The front side of panel-boards, i.e. the switch and circuit-breaker operating face, shall be readily accessible, and the rear side, i.e. the terminal and connection side, accessible.

12.5 Connections and components on panel-boards shall be in locations protected from the weather, in conformity with IEC 60529:

— IP 67 as a minimum, if exposed to short-term immersion;

— IP 56 as a minimum, if exposed to splashing water;

— IP 20 as a minimum, if located in protected locations inside the craft.

12.6 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 be clearly identified. Wiring diagrams to identify circuits, components and conductors shall be included with the craft.

13 Receptacles/sockets

13.1 Receptacles/sockets and matching plugs used on a.c. systems shall not be interchangeable with those used in the d.c. system on the craft.

13.2 Receptacles/sockets installed in locations subject to rain, spray or splashing shall be able to be enclosed in IP 55 enclosures, in accordance with IEC 60529, as a minimum, when not in use. Receptacles mated with the appropriate plug shall also remain sealed, in accordance with IEC 60529.

13.3 Receptacles/sockets installed in areas subject to flooding or momentary submersion shall be in IP 56 enclosures, in accordance with IEC 60529, as a minimum, also meeting these requirements when in use with electrical plugs.

13.4 Receptacles/sockets shall be of the earthing type with a terminal provided for the protective conductor.

13.5 Receptacles/sockets provided for the galley area shall be located so that appliance cords may be plugged in without crossing above a galley stove or sink or across a traffic area.

13.6 Receptacles/sockets shall have a voltage rating in accordance with the voltage supplied by the power sources.

14 Power-source options

14.1 Power for the a.c. system shall be supplied by one of the following means:

a) single shore-power cable, power inlet, wiring and components with a capacity to supply the required design-system load;

b) multiple shore-power cables, power inlets, wiring and components with a capacity to supply the required design-system load;

c) inverter supplying a.c. power from the craft's d.c. system;

d) on-board a.c. generator(s) supplying the required system load;

e) combination of shore-power cable(s) and on-board generator(s) used simultaneously if the craft's circuitry is arranged such that the load connected to each source is isolated from the other in accordance with 4.6.

14.2 The shore-power cable(s) capacity alone, or with on-board generator(s) capacity in addition, shall be at least as large as the required system load(s).

14.3 A.c. generators, where installed, shall be connected to the electrical distribution system as required in 4.6 or protected in accordance with 4.7.

14.4 The power-feeder conductor from the a.c. generator shall be sized to transmit at least the generator's maximum rated output and shall be protected at the generator with overcurrent protection devices with a rating such that 120 % of the generator nominal output is not exceeded.

An exception may be made for self-limiting (self-adjusting) generators whose maximum overload current does not exceed 120 % of its rated current output; these do not require additional external overcurrent protection.

Annex A
(normative)

Conductor requirements

Table A.1 gives allowable continuous current ratings, in amperes, at different temperature ratings and the minimum number of strands for conductors. These values have been determined for an ambient temperature of 30 °C and apply to single conductors and stranding when no more than three conductors are bundled together.

For conductors in engine rooms (60 °C ambient) or when more than three conductors are bundled together, the maximum current rating in Table A.1 shall be derated by the factors listed below:

Temperature rating of conductor insulation:	Multiply maximum current from Table A.1 by:
70 °C	0,75
85 °C to 90 °C	0,82
105 °C	0,86
125 °C	0,89
200 °C	1

Number of conductors bundled:	Multiply maximum amperage from Table A.1 by:
4 to 6	0,7
7 to 24	0,6
25 or more	0,5

NOTE Derating reductions for temperature and bundling are cumulative.

Tableau A.1 — Cross-sectional area of conductor, allowable continuous current and stranding

Cross-sectional area	Maximum continuous current-carrying capacity, in amperes, for single conductors at insulation temperature ratings						Minimum number of strands	
mm^2	60 °C	70 °C	85 °C to 90 °C	105 °C	125 °C	200 °C	Type A	Type B
0,75	6	10	12	16	20	25	16	—
1	8	14	18	20	25	35	16	—
1,5	12	18	21	25	30	40	19	26
2,5	17	25	30	35	40	45	19	41
4	22	35	40	45	50	55	19	65
6	29	45	50	60	70	75	19	105
10	40	65	70	90	100	120	19	168
16	54	90	100	130	150	170	37	266
25	71	120	140	170	185	200	49	420
35	87	160	185	210	225	240	127	665
50	105	210	230	270	300	325	127	1 064
70	135	265	285	330	360	375	127	1 323
95	165	310	330	390	410	430	259	1 666
120	190	360	400	450	480	520	418	2 107
150	220	380	430	475	520	560	418	2 107

Conductors with at least Type A stranding shall be used for general wiring of the craft. Conductors with Type B stranding shall be used for any wiring where frequent flexing is involved during use.

NOTE Conductor current ratings may be interpolated for cross-sectional areas between those shown above.

Annex B
(normative)

Instructions to be included with owner's manual (ISO10240)

If an alternating current electrical system is installed in a craft, the owner's manual shall include instructions for the operation and maintenance of the system, including a wiring diagram with conductor identification, and at least the following.

a) Do not modify the craft's electrical systems or relevant drawings. Installation, alterations and maintenance should be performed by a competent marine electrical technician. Inspect the system at least biennially.

b) Disconnect shore-power connections when the system is not in use.

c) Connect metallic housings or enclosures of installed electrical appliances to the protective conductor system in the craft (green or green with a yellow stripe conductor).

d) Use double insulated or grounded (earthed) electrical appliances.

e) If the reverse polarity indicator is activated, do not use the electrical system. Correct the polarity fault before activating the electrical system on the craft.[2)]

f) **WARNING — Do not allow the shore-power cable end to hang in the water. An electrical field can be caused which can cause injury or death to nearby swimmers.**

g) **WARNING — To minimize shock and fire hazards.**

- **Turn off craft's shore-power connection switch before connecting or disconnecting shore-power cable.**
- **Connect shore-power cable to craft’s inlet before connecting to shore-power source.**[3)]
- **Disconnect shore-power cable at shore-power source first.**
- **If reverse polarity indicator is activated, disconnect cable immediately.**[4)]
- **Close shore-power inlet cover tightly.**

Do not alter shore-power cable connectors, use only compatible connectors.

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2) Required for polarized systems with polarity indicator.

3) Not required for permanently connected shore-power cable installations.

4) Required only if a reverse polarity indicator is required in the system.

Annex C
(informative)

Recommended system tests

The following system tests should be performed upon completion of the a.c. installation.

— Residual current device (RCD) testing.

— Continuity test of circuits, particularly ring and protective circuits.

— Insulation resistance testing at 500 V d.c. for each circuit.

— Polarity test at distribution and at each outlet.

CAUTION — Some electronic equipment may be damaged by high d.c. voltages.

Annex D
(informative)

Related standards and brief description of their contents

[1] ISO 10088:—[5)], *Small craft — Permanently installed fuel systems and fixed fuel tanks.*

Individual fuel tanks, 100 % pressure tested
Non-metallic fuel tanks, fire tested
Fire-resistant flexible fuel hoses
Fire test for non-metallic fuel-system components
Corrosion-resistant fuel-tank materials
Galvanically compatible metallic parts
Anti-siphon protection requirements
Double clamping of fuel-fill hoses
Electrically ground (earth) all metallic parts
100 % pressure test of entire fuel system

[2] ISO 8846:1990, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases.*

All components in petrol engines, petrol and LPG tank compartments to 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 further 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.

[3] ISO 9097:1991, *Small craft — Electric fans.*

[4] ISO 8849:1990, *Small craft — Electrically operated bilge-pumps.*

All components, if installed in a petrol engine, petrol or LPG tank compartment to be ignition-protected, have all wiring insulated, be suitable for marine environment, and not create a hazard when the motor is overloaded or stalled.

[5] ISO 10133:2000, *Small craft — Electrical systems — Extra-low-voltage d.c. installations*

All components fused
All conductors insulated
All electrical components installed in bilges or other compartments that may contain explosive gas are ignition protected
Installation requirements for batteries and cables
Requirements for ring or captive-spade terminals on conductor connectors

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5) To be published. (Revision of ISO 10088:1992)

[6] ISO 10239:—[6)], *Small craft — Liquefied petroleum gas (LPG) systems.*

System to withstand temperature extremes
Appliances approved and installed only in ventilated compartments, tanks and pressure regulators in lockers identified and vented with overboard drains
Meet specifications for fuel lines and their supports
Appliance well secured with flame-failure shutoff control device for each appliance.
Warning labels on appliances
Pressure test on installed system
Any electrical device in lockers, designated for fuel storage, ignition-protected

[7] ISO 9094–1:—[6)], *Small craft — Fire protection — Part 1: Craft with a hull length of up to and including 15 m.*

ISO 9094–2:—[6)], *Small craft — Fire protection — Part 2: Craft with a hull length of more than 15 m and up to and including 24 m.*

Specifications for exits and emergency exits
Material specifications in areas close to open flames
Self-extinguishing materials in engine compartment
Ventilation and flue protection for water heater
Sealed combustion systems on unattended appliances
Specification for fuel tanks
Requirement for portable fire-extinguishers, for accessibility, protection, stowage and locker identification size
Specification for number and types of fire-extinguishers
Specification for fixed fire-extinguishing system on some craft
Cylinder installation specification
Remote release for fixed systems
Fire-resistant distribution hoses and tubes
Specifications for discharge and control
Discharge and operating instructions

[8] ISO 11105:1997, *Small craft — Ventilation of petrol engine and/or petrol tank compartments.*

Ventilation amount based on compartment volume
Specification for compartment tightness
Natural and powered ventilation in engine compartments
Natural ventilation in certain fuel compartments
Ventilation openings on exterior of craft
Blower warning for craft operator

[9] ISO 10134:1993, *Small craft — Electrical devices — Lightning protection.*

Requirements for design, construction and installation of lightning-protection equipment, if fitted on small craft

[10] IEC 60364-7-709:1994, *Electrical installations of buildings — Part 7: Requirements for special installations or locations — Section 709: Marinas and pleasure craft*.

A.c. systems for marinas and connection to the craft

[6)] To be published.

ICS 47.080

Price based on 16 pages