INTERNATIONAL STANDARD

ISO 10133

Third edition
2012-12-15

Small craft — Electrical systems — Extra-low-voltage d.c. installations

Petits navires — Systèmes électriques — Installations à très basse tension à courant continu

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

Reference number
ISO 10133:2012(E)

© ISO 2012

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

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.org
Web www.iso.org

Published in Switzerland

© ISO 2012 – All rights reserved

Contents

Page

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

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 2.

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.

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

ISO 10133 was prepared by Technical Committee ISO/TC 188, *Small craft*.

This third edition cancels and replaces the second edition (ISO 10133:2000), which has been technically revised.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

Small craft — Electrical systems — Extra-low-voltage d.c. installations

1 Scope

This International Standard establishes the requirements for the design, construction and installation of extra-low-voltage direct current (d.c.) electrical systems which operate at nominal potentials of 50 V d.c. or less on small craft of hull length up to 24 m. Conductors that are part of an outboard engine assembly and that do not extend beyond the outboard engine manufacturer's supplied cowling are not included.

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

ISO 10239, *Small craft — Liquefied petroleum gas (LPG) systems*

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

IEC 60529, *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
equipotential bonding conductor
normally non-current-carrying conductor used to put various exposed conductive parts of electrical devices and extraneous conductive parts at a substantially equal potential

3.2
engine negative terminal
terminal on the engine, starter or solenoid to which the negative battery cable is connected

3.3
main grounding
earthing point
main point or bus that provides connection to the common ground for the d.c. negative conductor, for a.c. protective grounding conductors and neutral, where relevant, and where necessary functional grounding

NOTE It may include any conductive part of the wetted surface of the hull in permanent contact with the water, depending on the overall system design.

3.4
ignition-protected equipment
equipment designed and constructed to give protection against ignition of surrounding flammable gases

NOTE See ISO 8846.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

3.5
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.

3.6
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.

3.7
sheath
uniform continuous tubular protective covering of metallic or non-metallic material, generally extruded, around one or more insulated conductors

NOTE Examples of suitable material include moulded rubber, moulded plastics, woven sleeving or flexible tubing.

3.8
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 short circuits, and which is designed so that the resetting means cannot be manually held in place to override the current interrupting mechanism

3.9
conduit
part of a closed wiring system of circular or non-circular cross-sections for insulated conductors and/or cables in electrical installations allowing them to be drawn in and/or replaced

3.10
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

3.11
system voltage(s)
nominal voltage supplied to the d.c. distribution panel board (switchboard) from the power source

3.12
exposed conductive part
conductive part of electrical equipment, which can be touched and which is not normally live, but which can become live under fault conditions

3.13
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]

3.14
fully insulated two-wire d.c. system
system in which both positive and negative poles remain isolated from the ground (earth)

EXAMPLE Systems in which the positive and negative poles are not connected to the water through a metallic hull, the propulsion system or earthed through the a.c. protective conductor.

NOTE Some systems may use a momentary ground connection for engine starting purposes and may remain isolated.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

3.15
self-limiting
device whose maximum output is restricted to a specified value by its magnetic or electrical characteristics

3.16
two-wire d.c. system with negative ground (earth)
system in which the d.c. negative is connected to the ground through a metallic hull, the propulsion system or other means

4 General requirements

4.1 The system type shall be either a fully insulated two-wire d.c. system or a two-wire d.c. system with negative ground. Engine-mounted wiring systems can use the engine block as the grounded conductor.

For d.c. systems with a negative ground, the main grounding/earthing point shall be either:

a) the engine negative terminal; or

b) a main grounding bus of sufficient current-carrying capacity.

The hull shall not be used as a current-carrying conductor.

Systems with multiple battery banks shall have a common negative connection. Exceptions to this are for dedicated electrical systems isolated from a boat system, e.g. electric propulsion systems that are clearly identified as part of the isolated system.

4.2 An equipotential bonding conductor, if fitted, shall be connected to the craft's main grounding/earthing point.

4.3 All manually operated switches and controls shall be marked to indicate their use, unless the purpose of the switch is obvious and mistaken operation of it will not cause a hazardous condition.

4.4 Protective devices such as trip-free circuit breakers or fuses shall be provided at the source of power, e.g. the panel board (switchboard), to interrupt any overload current in the circuit conductors before heat can damage conductor insulation, connections or wiring system terminals.

4.5 The selection, arrangement and performance characteristics shall be such that:

a) there is a maximum continuity of service to healthy circuits where fault conditions exist in other circuits through selective operation of the various protective devices; and

b) electrical equipment and circuits are protected from damage due to overcurrents by coordination of the electrical characteristics of the circuit or apparatus and the tripping characteristics of the protective devices.

4.6 All d.c. equipment shall be capable of function within a voltage range of 75 % to 133 % of nominal voltage at the battery terminals, e.g.:

— for a 12 V system: 9 V to 16 V;

— for a 24 V system: 18 V to 32 V;

— for a 48 V system: 36 V to 64 V.

EXCEPTION Where the circuit includes equipment requiring a higher minimum voltage, the specified minimum voltage shall be used in the calculation of the conductor size. See Annex A.

4.7 The length and cross-sectional area of conductors in each circuit shall be such that the calculated voltage drop does not exceed 10 % of the nominal voltage.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

NOTE See Annex C for voltage drop calculations.

Circuits that typically require a 3 % voltage drop include:

a) panel board/switchboard main conductors;

b) navigation lights;

c) bilge blowers;

d) bilge pumps; and

e) other equipment vital to safety or where voltage drop should be kept to a minimum as specified by their manufacturer.

5 Batteries

5.1 Batteries shall be permanently installed in a dry, ventilated location above anticipated bilge water level.

5.2 Batteries shall be installed in a manner to restrict their movement horizontally and vertically considering the intended use of the craft, including trailering if applicable. A battery, as installed, shall not move more than 10 mm in any direction when exposed to a force corresponding to twice the battery weight.

5.3 Batteries as installed in the craft shall be capable of inclinations of up to 30° without leakage of electrolyte. Means shall be provided in monohull sailing craft for containment of any spilled electrolyte up to inclinations of 45°.

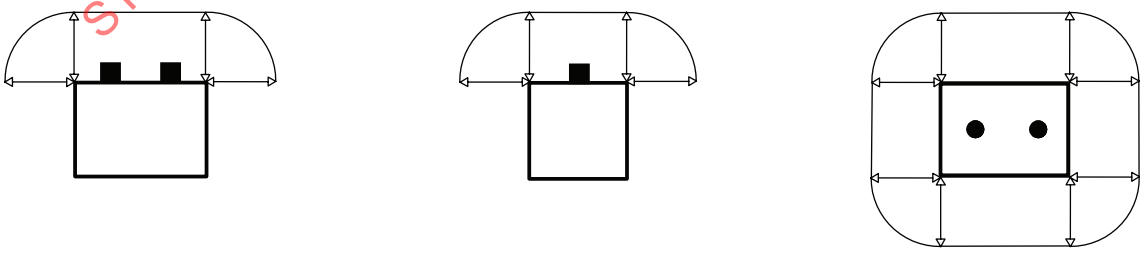
5.4 Batteries shall be installed, designed or protected so that metallic objects cannot come into unintentional contact with any battery terminal.

5.5 Batteries, as installed, shall be protected against mechanical damage at their location or within their enclosure.

5.6 Batteries shall not be installed directly above or below a fuel tank or fuel filter without an intervening deck or structure to isolate fuel components.

5.7 Any metallic component of the fuel system within 300 mm and above the battery top, as installed, shall be electrically insulated. See Figure 1.

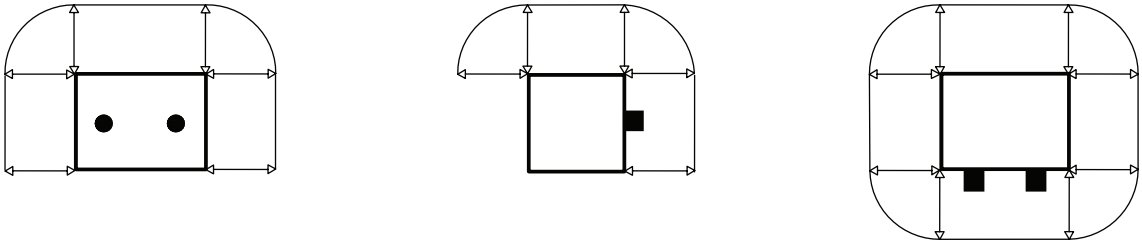
STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012



Front view **Side view** **Top view**

a) Top terminal battery

© ISO 2012 – All rights reserved



Front view **Side view** **Top view**

b) Side terminal battery

NOTE All indicated distances are minimum 300 mm.

Figure 1 — Free space around battery

5.8 Battery cable terminals shall not depend on spring tension for mechanical connection to the battery terminals. See Figure 1.

6 Battery-disconnect switch

6.1 A battery-disconnect switch shall be installed in the positive conductor of a system with earthed negative or the positive and negative conductor (simultaneously switched) of a fully insulated two-wire d.c. system. The disconnect switch shall be installed so it can be reached quickly and safely for effective use without the use of tools, and it shall be positioned as close as practical to the battery or group of batteries. The following constitute exceptions:

a) outboard-powered craft with engine starting and navigation lighting circuits only;

b) electronic devices with protected memory and protective devices such as bilge pumps and alarms if individually protected by a circuit breaker or fuse as close as practical to the battery terminal;

c) engine/fuel tank compartment ventilation exhaust blower if separately protected by a fuse or circuit breaker as close as practical to the battery terminal;

d) charging devices which are intended to be used when the craft is unattended (e.g. solar panels, wind generators) if individually protected by a fuse or circuit breaker as close as practical to the battery terminal.

6.2 The minimum continuous rating of the battery switch shall be at least equal to the maximum current for which the main circuit breaker is rated. For engine-starting circuits, the battery switch shall be rated appropriately for the engine starter that it serves.

6.3 Remote controlled battery disconnect switches, if used, shall also permit safe manual operation.

7 Conductors

7.1 Electrical distribution shall use insulated stranded copper conductors (see Table A.2). Conductor insulation shall be of fire-retardant material, e.g. not supporting combustion in the absence of flames.

7.2 Conductor insulation temperature rating in engine spaces shall be 70°C minimum, and rated oil-resistant, or shall be protected by insulating conduit or sleeving. Conductors shall be derated in allowable amperage capacity in accordance with Table A.1.

NOTE For additional conductor specifications, see ISO 6722[1].

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

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

7.4 Sheathed conductors and battery conductors to the battery disconnect switch shall be supported at maximum intervals of 300 mm with the first support not more than 1 m from the terminal, and other sheathed conductors at maximum intervals of 450 mm.

EXCEPTION Sheathed outboard starter motor conductors.

7.5 Conductors which could be exposed to physical damage shall be protected by sheaths, conduits or other equivalent means. Conductors which could be exposed to physical damage, including those passing through bulkheads or structural members, routing near sharp edges and any area where chafing may occur, shall be protected against insulation damage by chafing.

7.6 Conductors shall have minimum dimensions in accordance with Table A.2, or the conductor-manufacturer's rated current amperage and allowable voltage drop for the load to be carried. See 4.7 and 4.8.

7.7 Each conductor longer than 200 mm installed separately shall have an area of at least 1 mm^2. Each conductor in a multi-conductor sheath shall have an area of at least 0,75 mm^2 and can extend out of the sheath a distance not exceeding 800 mm.

EXCEPTION Conductors of minimum 0,75 mm^2 used as internal wiring in panel boards.

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

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

b) the cables are insulated for their system voltage and installed in a separate compartment of a cable conduit or trunking system;

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

d) separate conduits, sheathings or trunking systems are used;

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

7.9 All equipotential bonding conductors shall be identified by green or green with a yellow stripe insulation, or can be uninsulated. Conductors with green or green with a yellow stripe insulation shall not be used for current-carrying conductors.

NOTE The protective conductors of the a.c. electrical system (see ISO 13297) also uses green or green with a yellow stripe insulation and may be connected to the craft engine d.c. negative terminal.

7.10 Means of identification other than colour for d.c. positive conductors is permitted if properly identified on the craft wiring diagrams of the electrical system(s).

7.11 All d.c. negative conductors shall be identified by black or yellow insulation. If the craft is equipped with an a.c. electrical system in accordance with ISO 13297, which can use black insulation for live conductors, yellow insulation shall be used for d.c. negative conductors of the d.c. system. Black or yellow insulation shall not be used for d.c. positive conductors.

NOTE 1 In conformance with IEC 60446[14], conductor insulation colours of the a.c. system are:

— live conductors: black or brown;

— neutral conductors: white or light blue;

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

— protective conductors: green or green with a yellow stripe.

NOTE 2 A colour stripe may be added to conductor insulation for identification in the system.

Crafts with a.c. and d.c. systems shall avoid the use of brown, white or light blue insulation colour in the d.c. system, unless clearly separated from the a.c. conductors and identified as d.c.

NOTE 3 For additional conductor specifications see ISO 6722[1].

7.12 Current-carrying conductors of the d.c. system shall be routed above areas where water can accumulate, e.g. bilges, and at least 25 mm above the level at which the automatic bilge pump switch activates.

EXCEPTION If conductors have to be routed below anticipated bilge water level, the wiring and connections shall be in an IEC 60529 IP67 enclosure, as a minimum, and there shall be no connection below the foreseeable water level.

7.13 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.

8 Overcurrent protection

8.1 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. See Annex C.

EXCEPTION — This requirement does not include cranking motor conductors.

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.

Overcurrent protection is not required in conductors from self-limiting alternators with integral regulators if the conductor is less than 1 m, is connected to a source of power other than the battery, and is contained throughout its entire distance in a sheath or enclosure.

Conductors less than 200 mm in length are exempt from overcurrent protection requirements.

8.2 The voltage rating of each fuse or circuit breaker shall not be less than the nominal circuit voltage; the current rating shall not exceed the value for the smallest size conductor in the circuit.

8.3 Output circuits of self-limiting generators and battery chargers do not require fuses or circuit breakers.

9 Panel boards (switchboards)

9.1 Panel boards (switchboards) shall be installed such that the control elements, indicating instruments, circuit breakers and fuses are capable of being reached quickly and safely for effective use without the use of tools. The terminal side shall be capable of being reached for inspection, removal or maintenance without removal of permanent structures of the craft.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

9.2 Connections and components on panel boards shall be in locations protected from the expected conditions in conformity with IEC 60529:

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

— minimum IP 55 if exposed to splashing water;

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

9.3 Panel boards (switchboards) shall be permanently marked with the nominal system voltage.

EXAMPLE 12 V d.c. (or 6 V, 24 V, 32 V d.c., as appropriate for the craft).

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

NOTE Electrical controls required for proper operation of the craft (e.g. horns, navigation light) should be apparent to the operator when in normal use.

10 Wiring connections and terminals

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

10.2 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.

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

10.4 Screw-clamp terminals or screwless terminal blocks shall clamp conductors to ensure reliable mechanical linkage and electrical contact is properly maintained without bearing directly on conductor strands. 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.

10.5 Friction type connectors on conductors can be used in circuits not exceeding 20 A if the connection does not separate when subjected to a force of 20 N.

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

10.7 Exposed shanks of terminals shall be protected against accidental shorting by the use of insulation barriers or sleeves, except for those in the grounding system.

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

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

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

Table 1 — Tensile force

Conductor size mm^2	Tensile force N	Conductor size mm^2	Tensile force N	Conductor size mm^2	Tensile force 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

10.9 No more than four conductor terminals shall be secured to one terminal stud.

11 Socket outlets

11.1 Socket outlets and matching plugs used on d.c. systems shall not be interchangeable with those used on a.c. systems on the craft.

11.2 Socket outlets installed in locations subject to rain, spray or splash shall be protected to IEC 60529 IP55 as a minimum when not in use, e.g. protected by a cover with an effective weatherproof seal.

11.3 Socket outlets installed in areas subject to flooding or momentary submersion shall be protected to IEC 60529 IP 67 as a minimum, including when in use with connecting plugs.

12 Ignition protection

12.1 Electrical components and devices installed in compartments which can contain explosive vapour and gases shall be ignition-protected in accordance with ISO 8846.

NOTE ISO 10088 requires that all electrical components in petrol engines and petrol tank compartments (this applies to the entire engine, as well as all electrical contacts, commutators, brushes, collector rings, switches, relays, generators, fuses, distributors, engine-cranking motors, trim motors, etc.) be ignition-protected and ISO 10239 requires all electrical devices in LPG cylinder lockers and housings to be ignition-protected.

Compartments which can contain explosive gases are those containing or which have open connections with compartments containing items such as:

a) spark-ignition engines or their fuel tanks;

b) joints or fittings in fuel lines connecting spark-ignition engines with their fuel tanks.

Open compartments having 0,34 m^2 of open area per cubic metre of compartment volume exposed to the open atmosphere outside the craft constitute an exception to this requirement.

12.2 Electrical components installed in certain compartments in crafts with LPG systems, such as lockers and housings containing LPG cylinders and pressure regulators, shall be ignition-protected (ISO 8846) as required in ISO 10239.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

Annex A
(normative)

Conductor requirements

A.1 Table A.2 gives allowable maximum current ratings in amperes determined for 30 °C ambient temperature.

For conductors in engine rooms (60 °C ambient), the maximum current rating in Table A.2 shall be derated by the factors below.

Table A.1 — Derating of conductors in engine rooms

Temperature rating of conductor insulation, °C	Multiply maximum current from Table A.2 by:
70	0,75
85 to 90	0,82
105	0,86
125	0,89
200	1

A.2 As a guideline: the voltage drop (E) at load, in volts, can be calculated using the following formula:

$$E = \frac{0{,}0164 \times I \times L}{S}$$

where

S is the conductor cross-sectional area, in square millimetres;

I is the load current, in amperes;

L is the length, in metres, of conductor from the positive power source to the electrical device and back to the negative source connection.

NOTE On a 12 V system an approximation of a 3 % drop can be obtained by the following:

$$S = \frac{I \times L}{20}$$

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

Table A.2 — Conductor cross-sectional area, allowable maximum current and minimum stranding

Cross-sectional area mm^2	Allowable maximum current, in amperes, for single conductors at insulation temperature ratings						Minimum number of strands	
	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 craft wiring. Conductors with Type B stranding shall be used for any wiring where frequent flexing is involved in use.

NOTE 1 The tables in IEC 60092 are an alternative to Table A.2.

NOTE 2 Conductor allowable continuous current ratings may be interpolated for cross-sectional areas between those shown above.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved

Annex B
(normative)

Information and instructions to be included with owner's manual

B.1 The owner's manual shall be in accordance with ISO 10240 and shall include the following information:

a) diagram(s) identifying the electrical circuits of the craft with the locations of electrical devices in the craft and identification of conductors by colour or other means;

b) location and description of functions of electrical controls, dials, switches, fuses and also circuit breakers installed on the panel board.

B.2 The following advisory instructions shall be provided for the owner.

WARNING — Never:

a) work on the electrical installation while the system is energized;

b) modify the craft's electrical system or relevant drawings. Installation, alterations and maintenance should be performed by a competent marine electrical technician;

c) alter or modify the rated current amperage of overcurrent protective devices;

d) install or replace electrical appliances or devices with components which exceed the rated current amperage of the circuit;

e) leave the craft unattended with the electrical system energized, except automatic bilge pump, fire protection and alarm circuits.

STANDARDSISO.COM : Click to view the full PDF of ISO 10133:2012

© ISO 2012 – All rights reserved