INTERNATIONAL STANDARD

ISO 10133

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

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

Reference number
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Contents

Page

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

This second edition cancels and replaces the first edition (ISO 10133:1994), of which it constitutes a technical revision.

Annexes 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 information and 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 d.c. installation.

This International Standard is intended to provide protection against explosion and fires. It is important to realize that this standard is not intended to achieve this purpose by itself. 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 gas (LPG).

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

1 Scope

This International Standard specifies 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. Engine wiring as supplied by the engine manufacturer is not covered by this International Standard.

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 6722-3: 1993, *Road vehicles — Unscreened low-tension cables — Part 3: Conductor sizes and dimensions for thick-wall insulated cables*.

ISO 6722-4: 1993, *Road vehicles — Unscreened low-tension cables — Part 4: Conductor sizes and dimensions for thin-wall insulated cables*.

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

ISO 10239:—[1)], *Small craft — Liquefied petroleum gas (LPG) systems*.

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

ISO 13297:2000, *Small craft — Electrical systems — Alternating current installations*.

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*.

1) To be published.

3 Terms and definitions

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

3.1
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

3.2
engine negative terminal
terminal on the engine to which the negative battery cable is connected

3.3
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

3.4
ignition-protected equipment
equipment designed and constructed in accordance with ISO 8846

3.5
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

3.6
panel-board
switchboard

supporting panel on which are fixed devices for the purpose of controlling and/or distributing power on a craft

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

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

EXAMPLES 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 circuit, and which is designed so that the resetting means cannot be manually held in place to override the current-interrupting mechanism

3.9
accessible
capable of being reached for inspection, removal or maintenance without removal of the permanent structure of the craft

3.10
readily accessible
capable of being reached quickly and safely for effective use without the use of tools

3.11
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

3.12
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

3.13
system voltage
nominal voltage supplied to the d.c. distribution panel-board (switchboard) from the power source

3.14
exposed conductive part
conductive part of electrical equipment, which can be touched and which is not normally live, but which may become live under fault conditions

3.15
fuse
device that, by fusing of one or more of its specifically designed and proportioned components, opens the 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.

3.16
fully insulated two-wire d.c. system
system in which the d.c. negative is isolated from the ground (earth), i. e. not connected to the water through a metallic hull or the propulsion system, nor earthed through the a.c. protective conductor

3.17
two-wire d.c. system with negative ground
two-wire d.c. system with negative earth
system in which the d.c. negative is connected to the ground (earth) 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 a negative ground. The hull shall not be used as a current-carrying conductor. Engine-mounted wiring systems may use the engine block as the grounded conductor.

4.2 An equipotential bonding conductor, if fitted, shall be connected to the craft's ground (earth) to minimize stray current corrosion.

4.3 Switches and controls shall be marked to indicate their use, unless the purpose of the switch is obvious and its mistaken operation will not cause a hazardous condition.

4.4 Protective devices such as 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 the conductor insulation, connections or wiring-system terminals.

The selection, arrangement and performance characteristics should be such that the following is achieved:

a) maximum continuity of service to healthy circuits under fault conditions through selective operation of the various protective devices;

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

4.5 All d.c. equipment shall function over a voltage range at the battery terminals as follows:

— for a 12 volt system: 10,5 V to 15,5 V;

— for a 24 volt system: 21 V to 31 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 clause A.2.

4.6 The length and cross-sectional area of conductors in each circuit shall be such that the calculated voltage drop shall not exceed 10 % of the nominal battery voltage for any appliance, when every appliance in the circuit is switched on at full load.

5 Batteries

5.1 Batteries shall be permanently installed in a dry, ventilated location above the 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 The batteries installed in the craft shall be capable of inclinations of up to 30° without leakage of electrolyte. In monohull sailing craft, means shall be provided 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.

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

5.8 Battery cable terminals shall not depend on spring tension for mechanical connection to them.

6 Battery-disconnect switch

6.1 A battery-disconnect switch shall be installed in the positive conductor from the battery, or group of batteries, connected to the supply system voltage in a readily accessible location, as close as practical to the battery or group of batteries.

The following constitute exceptions:

a) outboard-powered craft with circuits for engine starting and navigation lighting 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) ventilation exhaust blower of engine/fuel-tank compartment 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 and also the intermittent load of the starter motor circuit, or the current rating of the feeder conductor, whichever is less. A separate battery-disconnect switch may be installed for the engine-cranking motor circuit.

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.1. Conductor insulation shall be of fire-retardant material, e.g. not supporting combustion in the absence of flame.

7.2 Conductors that are not sheathed shall be supported throughout their length in conduits, cable trunking, or trays, or by individual supports at maximum intervals of 300 mm.

7.3 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. Other sheathed conductors shall be supported at maximum intervals of 450 mm.

Sheathed outboard-motor starter conductors constitute an exception to this requirement.

7.4 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 damage to insulation by chafing.

7.5 Conductors shall have minimum dimensions in accordance with Table A.1, or the conductor manufacturer's rated current-carrying capacity, based on the load to be supplied and allowable voltage drop for the load to be carried. Conductors in voltage-critical circuits, such as starter motor circuits, navigation-light circuits and ventilation-blower circuits, whose output may vary with system voltage, shall be sized in compliance with the component manufacturer's requirements. See 4.5 and 4.6.

7.6 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 may extend out of the sheath a distance not to exceeding 800 mm.

An exception may be made for conductors of minimum area 0,75 mm^2 which may be used as internal wiring in panel-boards.

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

7.8 Each electrical conductor that is part of the electrical system shall have a means to identify its function in the system, except for conductors integral with engines as supplied by their manufacturers.