INTERNATIONAL STANDARD

ISO 10133

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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

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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 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.

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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).

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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.

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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

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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;

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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;

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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.

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

NOTE The protective conductor 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 d.c. negative terminal of the craft engine.

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

7.8.3 All d.c. negative conductors shall be identified by black or yellow insulation. If the craft is equipped with an a.c. electrical system (see ISO 13297) which may 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, conductor insulation colours of the a.c. system are

— live conductors: black or brown;

— neutral conductors: white or light blue;

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

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

Craft with a.c and d.c systems should avoid the use of a brown, white or light blue insulation colour in the d.c. system unless clearly separated from the a.c. conductors and identified (see 7.7).

7.8.4 Insulation-temperature ratings of conductors 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 clause A.1.

7.8.5 For additional conductor specifications, see ISO 6722-3 and ISO 6722-4.

7.8.6 Current-carrying conductors of the d.c. system shall be routed above anticipated levels of bilge water and in other areas where water may accumulate, or at least 25 mm above the 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 an IP 67 enclosure, in accordance with IEC 60529, as a minimum, and there shall be no connection below the foreseeable water level.

7.8.7 Conductors shall be routed away from exhaust pipes and other heat sources which can damage the insulation.

The minimum clearance of the conductors 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 or, if impractical, each conductor shall be contained within a protective covering, such as a sheathing conduit or cable trunking, for its entire length from the source of power to the circuit-breaker or fuse.

The following constitute exceptions.

a) The main power-feed circuit from the battery to an engine-cranking motor, if sheathed or supported to protect against abrasion and contact with conductive surfaces. See 7.2.

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b) The main power-feed from the battery to the panel-board (switchboard), distribution panel or fuse block, if sheathed or supported to protect against abrasion and contact with conductive surfaces. See 7.2.

If the fuse or circuit-breaker at the source of the supply conductor is sized to protect the smallest conductor in the circuit, only the fuse or circuit-breaker at the source is required.

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 conductor of smallest diameter 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 readily accessible. The terminal side shall be accessible.

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

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

— IP 55 as a minimum, if exposed to splashing water;

— IP 20 as a minimum, 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 d.c., 24 V d.c., 32 V d.c., as appropriate for the craft)

9.4 Craft equipped with both direct current (d.c.) and alternating current (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, with the craft.

10 Wiring connections and terminals

10.1 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.

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 attached to stud or screw connections.

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

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.

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

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

10.7 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.

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, 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

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

11 Receptacles/sockets

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

11.2 Receptacles/sockets installed in locations subject to rain, spray or splashing shall have a minimum protection of IP 55, in accordance with IEC 60529 when not in use, e.g. protected by a cover with an effective weatherproof seal.

11.3 Receptacles/sockets installed in areas subject to flooding or momentary submersion shall have a minimum protection of IP 67, in accordance with IEC 60529, including when in use with connecting plugs.

12 Ignition protection

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

Compartments which may contain explosive gases are those containing, or which have open connections with compartments containing, such items 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 craft with liquefied petroleum gas (LPG) systems, such as lockers and housings containing LPG cylinders and pressure regulators, shall be ignition-protected (see ISO 8846) as required in ISO 10239.

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Annex A
(normative)

Conductor requirements

A.1 Table A.1 gives allowable continuous current ratings, in amperes, determined for an ambient temperature of 30 °C, and the minimum number of strands for conductors.

For conductors in engine rooms (60 °C ambient), 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

A.2 As a guideline, the voltage drop E at load, in volts, may be calculated by the following formula:

$$E = \frac{0{,}016\,4 \times I \times L}{S}$$

where

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

I is the load current, in amperes;

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

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

Cross-sectional area	Maximum current, 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.

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Annex B
(normative)

Information and instructions to be included with owner's manual (ISO 10240)

B.1 The following information shall be included with the owner's manual:

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 warning instructions shall be provided for the owner.

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 exceeding 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.

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Annex C
(informative)

Recommended system tests

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

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

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

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

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Annex D
(informative)

Related standards and brief description of their contents

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).

[1] ISO 10088:—[2)], *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) major 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 7840:1994, *Small craft — Fire-resistant fuel hoses*.

Only fire-resistant fuel hoses may be used in petrol engine and petrol fuel-tank compartments. A flexible hose to be used between the engine and any solidly mounted metallic line to eliminate vibration failure. The hose to withstand fire, pressure, vacuum collapse, ozone and other environments, and have minimal fuel permeation.

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

[5] 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.

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

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[6] ISO 10239:—[3)], *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 LPG storage, ignition-protected

[7] ISO 9094-1:—[3)], *Small craft — Fire protection — Part 1: Craft with a hull length of up to and including 15 m*.

ISO 9094-2:—[3)], *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
Distribution hoses and tubes, fire-resistant
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] IEC 60092-350:1988, *Electrical installations in ships — Part 350: Low-voltage shipboard power cables. General construction and test requirements*.

[10] IEC 60092-352:1979, *Electrical installations in ships — Part 352: Choice and installation of cables for low-voltage power systems*.

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3) To be published.

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