



ICOMIA Global Conformity Guideline for ISO/ABYC Standards and Canadian TP 1332 requirements

*sponsored by ABYC, BMF, ICOMIA, IMCI, and NMMA
Author: Wieger de Wit*

Guideline Number 3 – Electrical

1. PURPOSE

This document was created by an international working group for use as a companion to the standards listed below. The creators of this document assume the users' familiarity with either the ABYC or ISO standards.

This document neither replaces nor guarantees compliance to either ABYC or ISO standards.

2. SCOPE

The information is presented in two separate yet similar Annexes. The annexes provide additional requirements in order to assess conformity to a parallel standard from another standard system. Access to the parallel standard is required to achieve compliance with that standard.

A.1 ABYC + ISO additional requirements = ISO compliance

A.2 ISO + ABYC additional requirements = ABYC & USCG compliance

3. Canadian Requirements (TP 1332)

For compliance with TP 1332 requirements the ABYC standard E-11 has to be applied. Labels shall be bilingual (English and French).

**GLOBAL COMPLIANCE APPENDIX A.1 – ELECTRICAL
ABYC + ISO ADDITIONAL PROVISIONS = ISO COMPLIANCE**

A.1.1. Referenced Organizations

This document shall be used in conjunction with the following standards:

International Organization for Standardization (ISO):

Small craft – Electrical Systems – Alternating current (AC) installations (ISO 13297:2001)

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 metres.

Small craft – Electrical Systems – Extra-low-voltage Direct Current (DC) installations (ISO 10133:2000)

1 SCOPE

This International Standard specifies the requirements for the design, construction and installation of extra-low voltage direct current (DC) electrical systems which operate at nominal potentials of 50 V DC 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.

American Boat & Yacht Council (ABYC):

E-11 AC and DC Electrical Systems on Boats - July 2008

11.1 SCOPE

These standards apply:

11.1.1 to alternating current (AC) electrical systems on boats operating at frequencies of 50 or 60 hertz and less than 300 volts, including shore powered systems up to the point of connection to the shore outlet and including the shore power cable and,

11.1.2. to direct current (DC) electrical systems on boats that operate at potentials of 50 volts or less.
EXCEPTION: Any conductor that is part of an outboard engine assembly and does not extend beyond the outboard engine manufacturer's supplied cowling.

A.1.2. Additional Requirement Matrix – AC Electrical Systems

MAJOR PARAGRAPH HEADING	ADDITIONAL ISO REQUIREMENTS
11.2 Scope	Note: ISO AC standards do not apply to 3 phase systems
11.5.2.2.8 Marking: Ignition Protection	ABYC requirements for Ignition Protection are SAE J1171 Marine or UL Marine – Ignition Protected. ISO requirement is ISO 8846.
11.5.5.3 AC Grounding Bus	Shall be connected as close as practicable to the battery (DC) negative terminal Shall be connected to metallic hulls at a location above any anticipated water accumulation.
11.5.5.8 Guarding of Energized Parts	Enclosures must provide IP 2X minimum and have a suitable warning sign
11.7 Galvanic Isolation	Galvanic isolators are part of this standard, in ABYC it is a separate standard
11.6.3.2 Shore Power Inlet Warning	Shore power inlets must be marked with voltage, current, the shock hazard symbol, and the “read owner’s manual” symbol.
11.6.3.2.3 Shore Power Inlet Sign	ABYC requires a sign at each <i>inlet</i> , ISO requires the sign to be at the <i>panel board</i>
11.10.2 Overcurrent Protection	ISO does not permit fuses for overcurrent protection in unpolarized systems
11.10.2.1.2 Overcurrent Device Rating	ABYC allows up to 150 % of allowable current in table VI or XII to accommodate standard device ratings. ISO does not allow exceeding the maximum values in table A.1.
11.14.3.7.2 Grounding Conductors	ABYC allows grounding conductor to be one size smaller than the current carrying conductors on circuits rated greater than 30 amperes. ISO requires it to be no less than current conductor.
11.14.6 Installation	When AC & DC is run together, ABYC requires only that they be kept separate. ISO Requires: a. For a multicore cable or cord, the cores of the AC circuit are separated from the cores of the DC circuit by an earthed metal screen of equivalent current-carrying capacity to that of the largest core of the AC circuit. b. The cables are installed on a tray or ladder where physical separation is provided by a partition. c. A separate conduit, sheathing or trunking system is used. d. The AC and DC conductors are fixed directly to a surface and separated by at least 100 mm. Conductors not in a sheath must be supported every 300 mm (11.8 in).

A.1.2. Additional Requirement Matrix – AC Electrical Systems (Continued)

MAJOR PARAGRAPH HEADING (ABYC Clause No)	ADDITIONAL ISO REQUIREMENTS (ISO Clause No)
11.14.6.6 Installation	Current-carrying conductors of the AC system shall be routed above foreseeable levels of bilge water and in other areas where water may accumulate, or at least 25 mm (1 in) 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 foreseeable water level.
11.14.6.9 Installation	ABYC allows up to four terminals to be secured to any one terminal stud. ISO indicates no more than 4 <i>conductors</i> shall be allowed on one terminal stud.
11.9.1.2 Panel boards	ABYC requires them to be weatherproof or be protected from weather and water splash ISO requires: 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.
11.9.3 Panel board Marking	AC panels must have a lamp to indicate the on/off function
11.13.1.1.1 Receptacles	ABYC requires “weatherproof when not in use” ISO requires 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.
11.13.1.1.2 Receptacles	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.
<i>Additional Requirements listed in ISO 13297</i>	
	Annex B Lists requirements for owners manuals
	Annex C Outlines required system tests

A.1.2. Additional Requirement Matrix – AC Electrical Systems (Continued)

MAJOR PARAGRAPH HEADING (ABYC Clause No)	ADDITIONAL REQUIREMENTS (ISO Clause No)
11.6.1.2 Battery Switches	ISO has no exception based on battery size nor does it except dedicated trolling motor battery banks. A battery switch must be provided in these cases.
E-10 Batteries	Batteries are to be installed above anticipated bilge levels. Installations must withstand 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°.
Battery Switch 11.6.1.2	ISO does not have 800 CCA exceptions nor does it exempt dedicated trolling motor battery banks. The specific exceptions are: 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.

A.1.3 Additional Requirement Matrix – DC Electrical Systems

MAJOR PARAGRAPH HEADING (ABYC Clause No)	ADDITIONAL ISO REQUIREMENTS (ISO Clause No)
11.14.6. Installation (cont'd)	<p>When AC and DC are run together, ABYC requires only that they be kept separate. ISO requires:</p> <ul style="list-style-type: none"> a. For a multicore cable or cord, the cores of the AC circuit are separated from the cores of the DC circuit by an earthed metal screen of equivalent current-carrying capacity to that of the largest core of the AC circuit. b. The cables are installed on a tray or ladder where physical separation is provided by a partition. c. A separate conduit, sheathing or trunking system is used. d. The AC and DC conductors are fixed directly to a surface and separated by at least 100 mm. <p>Conductors not in a sheath must be supported every 300 mm (11.8 in)</p> <p>Current-carrying conductors of the AC system shall be routed above foreseeable levels of bilge water and in other areas where water may accumulate, or at least 25 mm (1 in) above the water level at which the automatic bilge pump switch activates.</p> <p>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 foreseeable water level.</p> <p>Battery conductors to the battery disconnect switch must be supported every 300 mm (11.8 in) with the first support no more than 1 metre. Other sheathed conductors must be supported every 440 mm (18 in).</p>
11.14.4 Wiring Identification	If an AC system is installed yellow shall be used for the DC negative.
11.10.1.3 Overcurrent protection	ABYC allows up to 150 % of allowable current in table VI or XII to accommodate standard device ratings. ISO does not allow exceeding the maximum values in table A.1
11.9.1 Panel board	ABYC requires them to be weatherproof or be protected from weather and water splash ISO requires: 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.

11.9.2 Panel board Marking	DC panels must be marked with system voltage even if only one system voltage is installed.
11.9.2 & 11.9.3 Panel board Marking	On boats with both AC & DC systems wiring diagrams shall be included.

A.1.3 Additional Requirement Matrix – DC Electrical Systems (Continued)

MAJOR PARAGRAPH HEADING (ABYC Clause No)	ADDITIONAL ISO REQUIREMENTS (ISO Clause No)
11.13.1.1.1 Receptacles	ABYC requires “weatherproof when not in use” ISO requires 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.
11.13.1.1.2 Receptacles	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.

**GLOBAL COMPLIANCE APPENDIX A.2 – ELECTRICAL
ISO + ABYC ADDITIONAL PROVISIONS = ABYC + USCG COMPLIANCE**

A.2.1. Referenced Organizations

This document shall be used in conjunction with the following standards:

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO):

ISO 10133:2000 Small Craft – Extra-low-voltage DC Installations

1 Scope

This International Standard specifies the requirements for the design, construction and installation of extra-low voltage direct current (DC) electrical systems which operate at nominal potentials of 50 V DC 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.

ISO 13297:2001 Small Craft – Alternating Current Systems

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: Does not cover three-phase installations.

AMERICAN BOAT & YACHT COUNCIL (ABYC):

E-11 AC and DC Electrical Systems on Boats – July 2007/8

11.2 Scope

This standard applies:

11.2.1 to alternating current (AC) electrical systems on boats operating at frequencies of 50 or 60 hertz and less than 300 volts including shore powered systems up to the point of connection to the shore outlet and including the shore power cable,

and

*11.2.2 to direct current (DC) electrical systems on boats that operate at potentials of 50 volts or less
EXCEPTION: Any conductor that is part of an outboard engine assembly and does not extend beyond the outboard engine manufacturer's supplied cowling.*

E-10 Storage Batteries – July 2007/8

10.2 Scope

These standards and recommended practices apply to storage batteries used in direct current (DC) electrical systems on boats that operate at potentials of 50 volts or less.

A.2.2 Additional Requirement Table - ISO 13297 - Alternating Current Systems

SUBJECT HEADING (ISO Clause no.)	ADDITIONAL ABYC REQUIREMENTS (ABYC clause no.)
General requirements (4.1)	<p>The neutral for AC power sources shall be grounded.</p> <p>Shore power neutral is grounded through the shore power cable and shall not be grounded on board the boat.</p> <p>The secondary neutral of an isolation or polarization transformer shall be grounded at the secondary of an isolation transformer.</p> <p>The generator neutral shall be grounded at the generator (E-11.5.5.2)</p>
System wiring - <i>Conductor size</i> (10.2, Table A.1)	Add 10% to Table A.1 calculated conductor cross-section requirements. (E-11 AP Table 2)
Installation (11)	<p>Conductors terminating at panel-boards in junction boxes or fixtures shall have a length of conductor to relieve tension, allow for repairs and to permit multiple conductors to be formed at terminal studs. (E-11.14.6.11)</p> <p>In wet locations, metallic boxes, cabinets or enclosures shall be mounted to minimize the entrapment of moisture between box and adjacent structure. If air spacing, the minimum shall be ¼ inch (7 mm) (E.11.14.6.1.1)</p> <p>Non-metallic outlet boxes, flush device boxes and covers shall meet UL 514C <i>Non-metallic outlet boxes, flush device boxes and covers</i> (E-11.14.6.13.2)</p>
Panel-boards (switchboards) (12)	<p>Boats equipped with both AC and DC systems shall have their distribution on separate panel-boards, or in the case of systems with combined AC and DC panel-boards, the panel-board shall be designed so that when the panel is open there is no access to energized parts of the AC system without the use of tools. (E-11.9.1.1)</p> <p>If the frequency is other than 60 Hz, the frequency shall be indicated on the panel board (E-11.9.3.1.1)</p> <p>For three-phase systems the system voltage, phase and number of conductors shall be indicated on the panel-board (E-11.9.3.1.2)</p> <p>If the system is permanently connected to a motor circuit, a generator or an inverter/charger, install a system voltmeter on the main panel-board. (E-11.9.3.2)</p>

A.2.2 Additional requirement Table – ISO 13297 – Alternating Current Systems (continued)

SUBJECT HEADING (ISO Clause no.)	ADDITIONAL ABYC REQUIREMENTS (ABYC clause no.)
Receptacles/sockets (13)	<p>Receptacles shall be installed in boxes according to UL 514A Metallic Outlet Boxes, or 514C, <i>Non-metallic Outlet Boxes, Flush Device Boxes and Covers</i>. (E-11.13.3.1)</p> <p>Receptacles shall be of the grounding type with a terminal provided for the grounding (green) conductor (E-11.13.3.2)</p> <p>Power wiring for receptacles shall be connected so that the grounded (white) conductor attaches to the terminal identified by the word “white” or a light colour (normally white or silver). The ungrounded conductor(s) shall be attached to the terminals identified by a dark colour (normally brass or copper) and optionally, the letters X, Y Z or L1, L2 and L3. (E-11.13.3.3)</p> <p>A branch circuit supplying a combination of receptacle and permanently connected loads shall not supply permanent loads in excess of 600 Watts for a 15 Amp circuit, or 1000 W for a 20 Amp circuit. (E-11.13.3.4)</p>

A.2.3 Additional Requirement Table - ISO 10133 - Extra-low-voltage DC Installations

SUBJECT HEADING (ISO Clause No.)	ADDITIONAL ABYC REQUIREMENTS (ABYC Clause No.)
Batteries (5)	<p>Provision shall be made to contain incidental leakage and spillage of electrolyte (E-10.7.2)</p> <p>Batteries shall not be installed directly above or below fittings in fuel line without an intervening sole, floor or deck (E-10.7.5)</p> <p>Batteries shall not be installed, without an intervening layer, directly below electrical equipment susceptible to attack from corrosive gases (E-10.7.6)</p>
Conductors – <i>Minimum dimensions</i> (7.5, Table A.1)	Add 10% to Table A.1 calculated conductor cross-section requirements. (E-11 AP Table 2)
Conductors - <i>Wiring identification</i> (7.8)	If colour coded for identification, the DC positive conductor shall be red. (E-11.14.4.1.3 Table XIII)
Conductors - <i>Termination and Junction boxes</i> (7)	<p>Conductors terminating at panel-boards in junction boxes or fixtures shall have a length of conductor to relieve tension, allow for repairs and to permit multiple conductors to be formed at terminal studs. (E-11.14.6.11)</p> <p>In wet locations, metallic boxes, cabinets or enclosures shall be mounted to minimize the entrapment of moisture between box and adjacent structure. If air spacing, the minimum shall be ¼ inch (7 mm) (E.11.14.6.1.1)</p>
Receptacles/sockets (11)	Plugs and receptacles shall incorporate means such as cable clamps, moulded connectors, insulation grips, extended terminal barrels etc, for supporting all wires to limit flexing at the connection. (E-

	<p>11.13.2.1.1)</p> <p>Each terminal in multi-wire plug and receptacle shall be protected from accidental short-circuiting to adjacent terminals (E-11.13.2.2)</p> <p>Plug connectors shall have a minimum disengagement force along the axial direction of the connection of 6 lbs (2.75 kg), for 1 minute. (E-11.13.2.3)</p>
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Notes

1. This appendix is intended to be appended to ISO 10133 and ISO 13297 to provide the additional ABYC requirements relevant for DC and Ac electrical installations respectively
2. The content of this appendix is based on the electrical requirements comparison document supplied by ABYC/ICOMIA. Where ISO requirements exceed the relevant ABYC requirements no reference has been made to the requirements in this appendix. Where ISO and ABYC requirements are the same, or differ slightly, an assumption of equivalence has been made and no reference to the requirements has been made in this appendix. Equivalence has been assumed for the following:
 - Scope (ISO 10133 1, 13297 1 and E.11.2)
 - Battery installation strength (ISO 10133 5.3 and E.10.7.4.4)
 - Metallic components near batteries (ISO 10133 5.7 and E.10.7.8)
 - Battery cable support (ISO 10133 7.3 and E.11.14.6.8.3)
 - Weather protection at panel-boards (ISO 10133 9.2 and E.11.9.1.2)
 - Weather protection at connections (ISO 10133 10.1 and E.11.14.6.1)
 - Weather protection at receptacles/sockets (ISO 10133 11.2 and E.11.13.1.1.1)
 - Weather protection at receptacles/sockets (ISO 10133 11.3 and E.11.13.1.1.2)
 - Ignition protection (ISO 10133 12.1 and E.11.5.1.3.1)
3. The US Coast Guard recognizes equivalent testing done to ISO 8846.