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## Small craft — Electric propulsion system

*Petits navires — Système de propulsion électrique*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 188, *Small craft*, together with CEN/BT/WG 69, *Small craft* and IEC/TC 18, *Electrical installations of ships and of mobile and fixed offshore units*.

## Introduction

Electrical propulsion systems are becoming more common in recreational craft and other small craft and propulsion system voltages of up to AC 1 000 V and DC 1 500 V are possible together with variable speed drives operating at frequencies which differ from 50/60 Hz or DC.

Electric propulsion systems for small craft are generally designed and constructed from a number of component parts many of which can be of proprietary origin and all of the electrical and control items are interconnected by cables and operated as a system.

There are a significant number of electrical propulsion system architectures for small craft and the main types are the following.

- DC sourced. The main power source is a propulsion battery which is either recharged from on-board DC generators, or on-board AC generators/an AC shore supply through battery chargers. The electric propulsion system(s) may be variable speed through a DC motor controller or AC through a Variable Frequency Drive (VFD) or be fixed speed with a variable pitch propeller or other mechanical means of providing thrust. The electric propulsion system may be electrically separate from other electrical systems on board (e.g. be fully insulated via the motor controller, or be an AC IT system via a VFD or motor starter). Or the electrical propulsion system may be integrated with the whole craft DC electrical system using converters DC/DC, DC/AC to provide for different services/consumers.
- AC sourced. The main power source is AC generator(s) generally configured as TT, TN-C or TN-S. The electric propulsion system(s) may be DC variable speed through a AC/DC converter and DC motor controller, or AC through a VFD, or be fixed speed with a variable pitch propeller or other mechanical means of providing thrust. The electric propulsion system may be DC fully insulated system or be an AC IT system via a galvanically isolated VFD or via an isolating transformer. A DC propulsion system(s) may be supported by propulsion battery.
- Also possible are hybrid systems similar to the types being introduced for road vehicles where the source is an internal combustion engine providing, for example, energy to a relatively lightweight energy storage system with power take-off via converters to propulsion motor(s) and other electrical consumers.

It is essential that the electric propulsion system designer/installer be competent with all aspects of the equipment included in the design of a particular system such that the component parts of the propulsion system are integrated in a coherent and safe manner.

Current electrical standards for small craft of less than 24 m LH are the following:

- a) ISO 10133 which is limited to recommendation for the design, construction and installation of direct current systems that operate at a voltage of DC 50 V or less; and
- b) ISO 13297 which is limited to single phase alternating current electrical systems less than AC 250 V.

Neither of these standards includes requirements for electrical propulsion systems.

- c) IEC 60092-507 is applicable to small craft up to 50 m/500 GT and includes requirements for three-phase systems not exceeding AC 500 V and single-phase systems not exceeding AC 250 V and for DC systems and sub-systems not exceeding DC 50 V nominal, and includes a section on electric propulsion systems.

# Small craft — Electric propulsion system

## 1 Scope

This International Standard addresses the design and installation of alternating current (AC) and direct current (DC) electrical systems used for the purpose of electrical propulsion and/or electrical hybrid (system with both a rechargeable battery and a fuelled power source) propulsion.

This International Standard applies to electrical propulsion systems operated in the following ranges either individually or in combination:

- direct current of less than 1 500 V DC;
- single-phase alternating current up to AC 1 000 V;
- three-phase alternating current up to AC 1 000 V.

This International Standard applies to electrical propulsion systems installed in small craft up to 24 m length of the hull ( $L_H$  according to ISO 8666).

This International Standard also lists in [Annex A](#) additional information to be included in the owner's manual as well as Annex B additional information to be provided to the installer.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 9094, *Small craft — Fire protection*
- ISO 10133:2012, *Small craft — Electrical systems — Extra-low-voltage d.c. installations*
- ISO 10239, *Small craft — Liquefied petroleum gas (LPG) systems*
- ISO 10240, *Small craft — Owner's manual*
- ISO 11105, *Small craft — Ventilation of petrol engine and/or petrol tank compartments*
- ISO 13297:2014, *Small craft — Electrical systems — Alternating current installations*
- ISO 25197:2012, *Small craft — Electrical/electronic control systems for steering, shift and throttle*
- IEC 60079-series, *Electrical apparatus for explosive gas atmospheres*
- IEC 60092-202:1994/Amd 1:1996, *Electrical installation in ships — Part 202: System design — Protection*
- IEC 60092-303, *Electrical installation in ships — Part 303: Equipment — Transformers for power and lighting*
- IEC 60092-352, *Electrical installation in ships — Part 352: Choice and installation of electrical cables*
- IEC 60092-507:2014, *Electrical installations in ships — Part 507: Small vessels*
- IEC 60898-1, *Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations — Part 1: Circuit-breakers for a.c. operation*

IEC 60945, *Maritime navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results*

IEC 60947-2, *Low voltage switchgear and control gear — Part 2: Circuit breakers*

IEC 61558-2-4, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100 V — Part 2-4: Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V — Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*