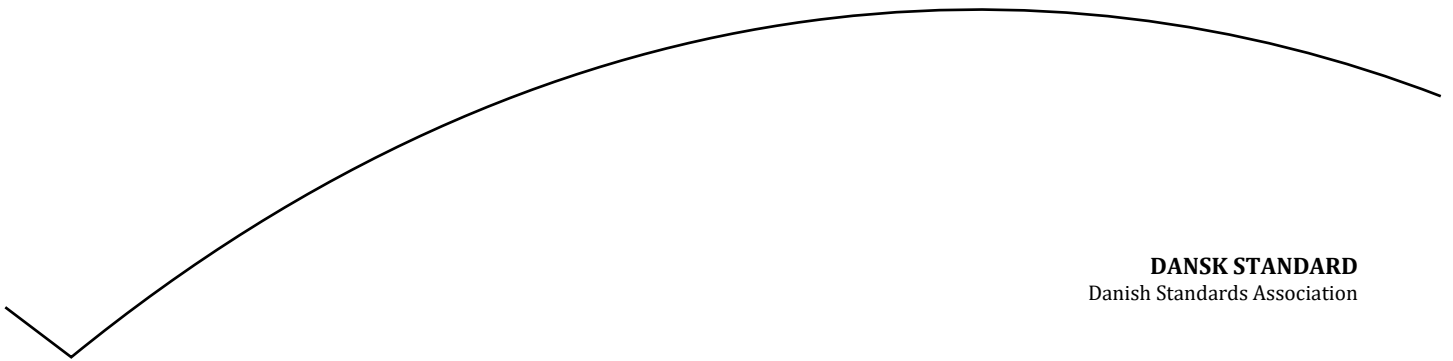


Mindre skibe – Systemer til elektrisk fremdrift

Small craft – Electrical systems used for electrical propulsion



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DS/ISO 16315:2026

København

DS projekt: M376949

ICS: 47.080

Første del af denne publikations betegnelse er:

DS/ISO, hvilket betyder, at det er en international standard, der har status som dansk standard.

IDT med: ISO 16315:2026

DS-publikationen er på engelsk.

Denne publikation erstatter: [DS/ISO 16315:2016](#)

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ISO 16315

Small craft — Electrical systems used for electrical propulsion

*Petits navires — Systèmes électriques utilisés pour la propulsion
électrique*

**Second edition
2026-02**

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Published in Switzerland

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This document was prepared by Technical Committee ISO/TC 188, *Small craft*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 464, *Small Craft*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16315:2016), which has been technically revised.

The main changes are as follows:

- the overcurrent protection requirements have been clarified;
- the fault monitoring requirements for isolated DC systems have been revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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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.

A propulsion system designer/installer should be competent with all components of the system addressed by this standard, as well as all aspects of any other equipment included in the design of a system such that the component parts of the propulsion system are integrated in a complete and safe manner.

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 or battery bank 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) can 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 can 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 can 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). The electric propulsion system(s) can be DC variable speed through an 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 can 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) can be supported by a propulsion battery or battery bank.
- 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 L_H are as follows:

- a) ISO 13297, which covers extra-low-voltage direct current (DC) electrical systems that operate at nominal potentials of 50 V DC or less and single-phase alternating current (AC) systems that operate at a voltage not exceeding AC 250 V. It does not include requirements for electrical propulsion systems.
- b) IEC 60092-507, which 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. It includes a section on electric propulsion systems.

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Small craft — Electrical systems used for electrical propulsion

1 Scope

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

This document is applicable 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 document is applicable to electrical propulsion systems installed in small craft up to 24 m length of the hull (L_H in accordance with ISO 8666).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 8665-2, *Small craft — Power measurements and declarations — Part 2: Electric marine propulsion*

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

ISO 13297, *Small craft — Electrical systems — Alternating and direct current installations*

ISO 25197, *Small craft — Electrical/electronic control systems for steering, shift and throttle*

IEC 60034-1, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60092-202, *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, *Electrical installations in ships — Part 507: Small vessels*

IEC 60146-1-1:2024, *Semiconductor converters — General requirements and line commutated converters — Part 1-1: Specification of basic requirements*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors*

IEC 60898-1, *Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations — Part 1: Circuit-breakers for a.c. operation*

IEC 60947-1, *Low-voltage switchgear and controlgear — Part 1: General rules*

transformers for general applications

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

safety voltage

<alternating current (AC)> voltage which does not exceed AC 50 V root mean square (rms) between *conductors* (3.19), or between any conductor and earth, in a circuit isolated from the supply by means such as a safety isolating *transformer* (3.22), or converter with separate winding

Note 1 to entry: Consideration should be given to the reduction of the limit of 50 V under certain conditions, such as wet surroundings or exposure to heavy seas or where direct contact with *live parts* (3.9) is involved.

Note 2 to entry: The voltage limit should not be exceeded either at full load or no load, but it is assumed, for the purpose of this definition, that any transformer or converter is operated at its rated supply voltage.

3.2

safety voltage

<direct current (DC)> voltage which does not exceed 50 DC V between *conductors* (3.19), or between any conductor and earth, in a circuit which is isolated from higher voltage circuits

Note 1 to entry: Consideration should be given to the reduction of the limit of 50 V under certain conditions, such as wet surroundings or exposure to heavy seas or where direct contact with *live parts* (3.9) is involved.

Note 2 to entry: The voltage limit should not be exceeded either at full load or no load, but it is assumed, for the purpose of this definition, that any *transformer* (3.22) or converter is operated at its rated supply voltage.

3.3

rated voltage

U_{0_TN}
<TN systems> nominal alternating current (AC) root mean square (rms) line voltage to earth

[SOURCE: IEC 60092-507:2014, 3.1.4]

3.4

rated voltage

U_{0_IT}
<IT systems> nominal alternating current (AC) root mean square (rms) voltage between *line conductor* (3.21) and *neutral conductor* (3.20)

[SOURCE: IEC 60092-507:2014, 3.1.4]

3.5

rated voltage

U_{0_DC}
<direct current (DC) systems> nominal DC voltage between poles

[SOURCE: IEC 60092-507:2014, 3.1.4]

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$U_{\max_IT}$
<IT systems> measured maximum alternating current (AC) root mean square (rms) voltage between *line conductor* (3.21) and *neutral conductor* (3.20)

3.7
maximum voltage

$U_{\max_DC}$
<direct current (DC) systems> the measured maximum DC voltage between poles

3.8
maximum voltage

$U_{\max_TN}$
<TN systems> measured maximum alternating current (AC) root mean square (rms) line voltage to earth

3.9
live part

conductor (3.19) or conductive part intended to be energized in normal operation including a *neutral conductor* (3.20), but by convention not a PEN conductor (a conductor combining the functions of both a *protective conductor* (3.17) and a neutral conductor)

Note 1 to entry: This term does not necessarily imply risk of electric shock.

[SOURCE: IEC 60050-195:2021, 195-02-19, modified — “or a PEM conductor or PEL conductor” deleted. Text in brackets added.]

3.10
earthed

grounded, en US

connected to the general mass of the hull of the craft in such a manner as will ensure at all times an immediate discharge of electrical energy without danger

[SOURCE: IEC 60092-101:2018, 1.3.9]

3.11
readily accessible

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

[SOURCE: ISO 13297:2020, 3.24]

3.12
final circuit

portion of a wiring system extending beyond the final *overcurrent protection device* (3.13) for that circuit

[SOURCE: IEC 60092-101:2018, 1.3.17, modified — “for that circuit” replaced “of a board”.]

3.13
overcurrent protection device

device provided to interrupt an electric circuit in case the conductor current in the electric circuit exceeds a predetermined value for a specified duration

[SOURCE: IEC 60050-826:2004, 826-14-14]

3.14
fuse

device that by the 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 1 to entry: The fuse comprises all the parts that form the complete device.

[SOURCE: IEC 60050-441:1984, 441-18-01]

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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 a short circuit

[SOURCE: IEC 60050-441:1984, 441-14-20]

3.16
residual current device
RCD

mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

[SOURCE: IEC 60050-442:1998, 442-05-02, modified — Note deleted.]

3.17
protective conductor
PE

conductor ([3.19](#)) provided for purposes of safety, for example, protection against electric shock

Note 1 to entry: In an electrical installation, the conductor identified PE is normally also considered as a protective earthing conductor.

[SOURCE: IEC 60050-195:2021, 195-02-09]

3.18
bond

connection of non-current-carrying parts to ensure continuity of electrical connection, or to equalize the potential between parts comprising, for example, the armour or cable screen of adjacent length of cable or the bulkhead

[SOURCE: IEC 60092-101:2018, 1.3.7, modified — “cables in a radio-receiving room” deleted.]

3.19
conductor

conductive part intended to carry a specified electric current

[SOURCE: IEC 60050-195:2021, 195-01-07]

3.20
neutral conductor

conductor ([3.19](#)) electrically connected to the neutral point and capable of contributing to the distribution of electrical energy

[SOURCE: IEC 60050-195:2021, 195-02-06]

3.21
line conductor

DEPRECATED: phase conductor (in AC systems)

DEPRECATED: pole conductor (in DC systems)

conductor ([3.19](#)) which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a *neutral conductor* ([3.20](#))

[SOURCE: IEC 60050-195:2021, 195-02-08]

3.22
transformer

energy converter with isolating separation between the input and output windings and the *protective conductor* ([3.17](#))

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mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions, which can include specified operating overload conditions, and also carrying for a specified time currents under specified abnormal circuit conditions such as those of a short circuit

Note 1 to entry: A switch can be capable of making but not breaking short-circuit currents.

3.24

panel board

assembly of devices, such as *circuit-breakers* ([3.15](#)), *fuses* ([3.14](#)), *switches* ([3.23](#)), instruments and indicators, for the purpose of controlling and/or distributing electrical power

Note 1 to entry: Examples of devices include circuit-breakers, fuses, switches, instruments and indicators.

3.25

disconnector

mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements

[SOURCE: IEC 60050-441:1984, 441-14-05]

3.26

battery

collection of cells wired in series (or series/parallel) and constituting a single physical unit

[SOURCE: ISO 23625:2025, 3.2]

3.27

battery bank

set of *batteries* ([3.26](#)) electrically connected (parallel/series) to increase capacity and/or voltage

[SOURCE: ISO 23625:2025, 3.3]