



IEC 60092-501

Edition 6.0 2025-08

# INTERNATIONAL STANDARD

---

**Electrical installations in ships -  
Part 501: Special features - Electric propulsion plant**



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2025 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

**About the IEC**

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

**About IEC publications**

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

**IEC publications search -**  
[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**  
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

**IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**  
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

**IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)**

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

**Electropedia - [www.electropedia.org](http://www.electropedia.org)**

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD .....	4
INTRODUCTION .....	6
1 Scope .....	7
2 Normative references .....	7
3 Terms, definitions and abbreviated terms .....	8
3.1 Terms and definitions .....	8
3.2 Abbreviated terms .....	11
4 System .....	12
4.1 System design .....	12
4.1.1 General .....	12
4.1.2 Design requirements .....	13
4.1.3 Blocking devices for shafts .....	13
4.1.4 Permanently excited motors .....	13
4.1.5 Special requirements for ships with only one propeller shaft .....	13
4.1.6 Special requirements for ships with more than one propeller shafts .....	13
4.2 System responsibility .....	13
4.3 Torsional stress and torsional vibrations .....	14
4.4 Protection and operational stability .....	14
4.5 Protection against moisture and condensation .....	14
4.6 Excitation systems .....	14
4.6.1 General requirements .....	14
4.6.2 Power sources .....	15
4.6.3 Propulsion motors .....	15
4.7 Wires, cables, busbars, trunking systems .....	16
5 Electromagnetic compatibility (EMC) and harmonic distortion .....	16
5.1 General .....	16
5.2 Electromagnetic interference (EMI), transients and total harmonic distortion (THD) .....	16
5.3 Special power distribution zone .....	16
6 Prime movers .....	17
6.1 General requirements .....	17
6.2 Speed deviations .....	17
6.3 Parallel operation .....	17
6.4 Regenerated energy from propeller .....	17
7 Generators and other power sources .....	18
7.1 Electric generators .....	18
7.1.1 General requirements .....	18
7.1.2 Bearings and lubrication .....	18
7.1.3 Cooling .....	19
7.1.4 Protection .....	19
7.1.5 Test .....	19
7.2 Other power sources .....	19
8 Propulsion switchboards .....	19
8.1 General .....	19
8.2 Instrumentation .....	19
8.3 Test .....	19

9	Propulsion transformers .....	20
9.1	General requirements.....	20
9.1.1	General.....	20
9.1.2	Degree of protection.....	20
9.2	Cooling.....	20
9.2.1	Liquid-cooled transformers.....	20
9.2.2	Air-cooled transformers .....	20
9.2.3	Air-forced/water-cooled transformers .....	21
9.3	Protection .....	21
9.4	Test .....	21
10	Converters .....	21
10.1	General .....	21
10.2	Design of semiconductor converters .....	22
10.3	Cooling of semiconductor converters .....	22
10.4	Protection .....	22
10.5	Test .....	23
11	Harmonic filtering .....	23
12	Propulsion motors.....	24
12.1	General requirements.....	24
12.2	Bearings and lubrication.....	24
12.3	Cooling of propulsion motors .....	24
12.4	Protection against moisture and condensate.....	24
12.5	Protection .....	25
12.5.1	Overcurrent.....	25
12.5.2	Overspeed of the propulsion motors.....	25
12.6	Tests.....	25
12.7	Short-circuit withstand capability .....	25
12.8	Accessibility and facilities for repairs in-situ.....	25
13	Special requirements for podded drives .....	26
13.1	General requirements.....	26
13.2	Sensors .....	26
13.2.1	General requirements.....	26
13.2.2	Bearings .....	26
13.2.3	Bilges .....	27
13.2.4	Fire alarm .....	27
13.2.5	Accessible areas.....	27
13.3	Protection of the propulsion motor against internal fault.....	27
13.4	Air humidity.....	27
13.5	Motor supply lines.....	27
13.6	Slip rings .....	28
13.6.1	General.....	28
13.6.2	Tests .....	28
13.7	Azimuth drive .....	31
13.7.1	General.....	31
13.7.2	Thrust azimuth angle.....	32
13.7.3	Control.....	32
13.7.4	Additional requirements on control stations for azimuth drives .....	32
13.7.5	Additional start permission.....	33

14	Control .....	33
14.1	General .....	33
14.2	Typical control configuration .....	33
14.3	Function description.....	34
14.4	Location of manoeuvring controls .....	35
14.5	Main and local control stations .....	35
14.6	Additional power management functions .....	36
14.6.1	General.....	36
14.6.2	Test.....	36
14.7	Measuring, indicating, control and monitoring equipment .....	36
14.7.1	General requirements .....	36
14.7.2	At local control station .....	36
14.7.3	At (main) control station on the bridge.....	37
14.7.4	At (main) control station in the engine control room .....	37
14.8	Availability .....	38
14.9	Start blockings .....	38
14.10	Factory acceptance test (FAT) .....	38
15	Tests.....	39
15.1	General .....	39
15.2	In-process tests.....	39
15.3	Factory acceptance test .....	39
15.4	Dock and sea trials .....	39
16	Documentation .....	40
Annex A (normative)	Protection and alert matrix .....	41
A.1	General .....	41
A.2	Protection and alerts .....	41
Bibliography	.....	44
Figure 1	– Typical equipment (configuration) for ships with two propellers (left) or one propeller (right) .....	12
Figure 2	– Typical control configuration .....	34
Figure A.1	– Propulsion equipment with monitored items .....	41
Table 1	– Permissible end temperature values.....	30
Table A.1	– Protection and alerts of the propulsion system .....	42

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **Electrical installations in ships - Part 501: Special features - Electric propulsion plant**

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60092-501 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units. It is an International Standard.

This sixth edition cancels and replaces the fifth edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) addition of podded drives including azimuth in the scope;
- b) addition of alternative power sources;
- c) modification of the special requirements for ships with only one propulsion motor;
- d) new definition for test of slip ring units;
- e) modification of Figure 2 and description;
- f) addition of a description of power management functions;

- g) addition of emergency stop at control stations;
- h) clearer start blockings;
- i) deletion of Table A.2, Table A.3 and Table A.4 in Annex A. Their content has been moved to Table 1.

The text of this International Standard is based on the following documents:

Draft	Report on voting
18/1982/FDIS	18/2001/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts in the IEC 60092 series, published under the general title *Electrical installations in ships*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

## INTRODUCTION

The IEC 60092 series forms a series of international standards for electrical installations in sea-going ships, incorporating good practices and coordinating as far as possible existing rules.

This series forms a code of practical interpretation and amplification of the requirements of the International Convention on Safety of Life at Sea, a guide for future regulations which may be prepared and a statement of practice for use by shipowners, ship builders and appropriate organizations.



## 1 Scope

This part of IEC 60092 applies to electric propulsion plants and specifies system design, installation and testing for equipment such as:

- generators and their prime movers or other power sources (fuel cell, battery, ...);
- switchboards;
- transformers/reactors;
- semiconductor converters;
- propulsion motors;
- excitation systems;
- control, monitoring and safety systems;
- wires, cables, busbars or trunking systems;
- podded drives including azimuth.

Thrusters intended either as auxiliary steering or auxiliary propulsion devices or both and booster equipment are excluded.

## 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.

IEC 60034 (all parts), *Rotating electrical machines*

IEC 60034-1:2022, *Rotating electrical machines - Part 1: Rating and performance*

IEC 60068-2-6:2007, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)*

IEC 60076 (all parts), *Power transformers*

IEC 60092-101:2018, *Electrical installations in ships - Part 101: Definitions and general requirements*

IEC 60092-202, *Electrical installations in ships - Part 202: System design - Protection*

IEC 60092-301, *Electrical installations in ships - Part 301: Equipment - Generators and motors*

IEC 60092-302-2:2019, *Electrical installations in ships - Part 302-2: Low voltage switchgear and controlgear assemblies - Marine power*<sup>1</sup>

IEC 60092-303, *Electrical installations in ships - Part 303: Equipment - Power transformers and reactors*

IEC 60092-352, *Electrical installations in ships - Part 352: Choice and installation of electrical cables*

---

<sup>1</sup> Applies in conjunction with IEC 61439-1:2020 and IEC 61439-2:2020.

IEC 60092-401, *Electrical installations in ships - Part 401: Installation and test of completed installation*

IEC 60092-503, *Electrical installations in ships - Part 503: Special features - AC supply systems with voltages in the range of above 1 kV up to and including 36 kV*

IEC 60092-504:2016, *Electrical installations in ships - Part 504: Automation, control and instrumentation*

IEC 60146 (all parts), *Semiconductor converters*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60533, *Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a metallic hull*

IEC 61180, *High-voltage test techniques for low-voltage equipment - Definitions, test and procedure requirements, test equipment*

IEC 61378-1, *Converter transformers - Part 1: Transformers for industrial applications*

IEC 61439-1:2020, *Low-voltage switchgear and controlgear assemblies - Part 1: General rules*

IEC 61439-2:2020, *Low-voltage switchgear and controlgear assemblies - Part 2: Power switchgear and controlgear assemblies*

IEC 61800 (all parts), *Adjustable speed electrical power drive systems*

IEC 62271-200:2021, *High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*  
IEC 62271-200:2021/AMD1:2024

IEC 62477 (all parts), *Safety requirements for power electronic converter systems and equipment*

IMO Resolution MSC.137(76):2002, Annex 6, *Standards for Ship Manoeuvrability*

*International Convention for the Safety of Life at Sea (SOLAS):1974, Consolidated edition 2014*