

INTERNATIONAL STANDARD

**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**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 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 Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
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

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 It also gives information on projects, replaced and withdrawn publications.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

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

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

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

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

INTERNATIONAL STANDARD

**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**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 47.020.60

ISBN 978-2-8322-1039-2

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 and definitions	8
4 General requirements	9
4.1 Environmental conditions	9
4.2 System design	9
4.3 Personnel safety	9
4.4 Operational safety.....	9
4.5 Integrity of external power supply.....	9
4.6 Electrical and mechanical interlockings	10
4.7 Selection criteria for distribution systems	10
4.8 Distribution systems network earthing	10
4.9 Divided system	11
5 Insulation.....	11
5.1 Selection of insulation level.....	11
5.1.1 General	11
5.1.2 Lightning impulse withstand voltage.....	11
5.1.3 Consideration of rated withstand voltages.....	11
5.2 Verification of clearance and creepage distances.....	11
5.2.1 Clearance distance	11
5.2.2 Creepage distance.....	12
5.3 Voltage and frequency	12
6 Electrical protection	13
6.1 General.....	13
6.2 Voltage-transformer protection.....	13
6.3 Overvoltage protection	13
6.4 Earth-fault monitoring	14
7 High voltage equipment	14
7.1 General.....	14
7.1.1 Ingress protection	14
7.1.2 Earthing of current and voltage transformers	14
7.1.3 Safe earthing measures	14
7.1.4 Accumulation of moisture and condensation	15
7.1.5 Liquid cooling	15
7.1.6 Terminals	15
7.2 Switchgear and controlgear assemblies	15
7.2.1 Design and construction	15
7.2.2 Handrails.....	16
7.2.3 Door opening.....	16
7.2.4 Encapsulation.....	16
7.2.5 Internal arc classification	16
7.2.6 Continuous (common) busbar compartment.....	16
7.2.7 Busbars of main switchboards	17
7.2.8 Generator circuits	17

7.2.9	Outgoing circuits.....	17
7.2.10	Power-transformer circuits.....	17
7.2.11	Shore-connection circuits.....	17
7.2.12	Earthing switches.....	17
7.2.13	Earthing of equipment.....	18
7.2.14	Auxiliary circuits.....	18
7.3	Generators and motors.....	18
7.3.1	General.....	18
7.3.2	Installation.....	18
7.3.3	Encapsulation.....	18
7.3.4	Temperature monitoring.....	18
7.3.5	Stator winding circuit arrangement.....	18
7.3.6	De-excitation.....	18
7.4	Transformers and reactors.....	19
7.4.1	General.....	19
7.4.2	Enclosures and installation.....	19
7.4.3	Encapsulation.....	19
7.4.4	Temperature monitoring.....	19
7.5	Converters.....	19
7.5.1	General.....	19
7.5.2	Encapsulation.....	19
7.6	Cables.....	20
7.6.1	General.....	20
7.6.2	Installation.....	20
7.6.3	Conductors and terminations.....	20
7.6.4	Testing.....	20
7.7	System test.....	21
8	Installation requirements for high voltage equipment.....	21
8.1	Access.....	21
8.2	Identification and marking.....	21
8.2.1	General.....	21
8.2.2	Labelling.....	21
8.2.3	Information plates and warning plates.....	22
8.2.4	Installations with incorporated capacitors.....	22
	Bibliography.....	23
	Table 1 – Minimum clearance.....	12
	Table 2 – AC three-phase systems having a nominal voltage above 1 kV and up to and including 36 kV.....	13
	Table 3 – Minimum IP ratings.....	14

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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****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, accept 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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60092-503 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 third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

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

- a) modified the scope, increasing the voltage from 15 kV to 36 kV;
- b) reference to IEC 61936-1 added;
- c) included relevant parts of the IEC 62271 series;
- d) removed low-impedance earthed neutral systems;
- e) updated 7.7 on system test;

f) added requirements for switchgear and switchboards.

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

Draft	Report on voting
18/1734/FDIS	18/1742/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. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/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 in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 60092 (all parts) forms a series of International Standards for electrical installations in sea-going ships, incorporating good practice and coordinating, as far as possible, existing rules.

These standards form 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, shipbuilders and appropriate organizations.

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

1 Scope

This part of IEC 60092 is applicable to AC supply systems with voltages from 1 kV up to and including 36 kV. The requirements contained in other parts of the IEC 60092 series apply where appropriate, subject to the exceptions stated in the clauses of this document.

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 60038, *IEC standard voltages*

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60076 (all parts), *Power transformers*

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

IEC 60092-201, *Electrical installations in ships – Part 201: System design – General*

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

IEC 60092-303, *Electrical installations in ships – Part 303: Equipment – Transformers for power and lighting*

IEC 60092-304, *Electrical installations in ships – Part 304: Equipment – Semiconductor converters*

IEC 60092-350, *Electrical installations in ships – Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications*

IEC 60092-353, *Electrical installations in ships – Part 353: Power cables for rated voltages 1 kV and 3 kV*

IEC 60092-354, *Electrical installations in ships – Part 354: Single- and three-core power cables with extruded solid insulation for rated voltages 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)*

IEC 60282-1, *High-voltage fuses – Part 1: Current-limiting fuses*