IEC/IEEE 80005-3

Edition 1.0 2025-12

INTERNATIONAL STANDARD

Utility connections in port -
Part 3: Low-voltage shore connection (LVSC) systems - General requirements

ICS 47.020.60

ISBN 978-2-8327- 0891-0

IEC/IEEE 80005-3:2025-12 (en)

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2025 IEC/IEEE

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 IEC, ISO or IEEE at the respective address given below.

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

ISO copyright office
Case postale 56
CH-1211 Geneva 20
Switzerland
Tel.: +41 22 749 01 11
copyright@iso.org
www.iso.org

Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue
New York, NY 10016-5997
United States of America
stds.info@ieee.org
www.ieee.org

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 the IEEE
IEEE is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire a global community through its highly cited publications, conferences, technology standards, and professional and educational activities.

About IEC/IEEE publications
The technical content of IEC/IEEE publications is kept under constant review by the IEC and IEEE. 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 It also gives information on projects, replaced and withdrawn publications.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 Products & Services Portal - 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
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 and definitions 9
4 General requirements 11
4.1 System description 11
4.2 Distribution system 12
4.2.1 General 12
4.2.2 Equipotential bonding 13
4.3 Compatibility assessment before connection 13
4.4 LVSC system design and operation 13
4.4.1 System design 13
4.4.2 System operation 14
4.5 Personnel safety 14
4.6 Design requirements 14
4.6.1 General 14
4.6.2 Protection against moisture and condensation 14
4.6.3 Location and construction 14
4.6.4 Electrical equipment in hazardous areas 15
4.7 Electrical requirements 15
4.8 System study and calculations 16
4.9 Emergency shutdown including emergency-stop facilities 16
5 LV shore supply system requirements 17
5.1 Voltages and frequencies 17
5.2 Quality of LV shore supply 19
6 Shore-side installation 19
6.1 General 19
6.2 System component requirements 19
6.2.1 Shore-side main circuit-breaker 19
6.2.2 Shore power transformer 20
6.2.3 System earthing methodology 20
6.2.4 Protective earthing 20
6.2.5 Equipotential bonding 20
6.3 Shore-to-ship electrical protection system 21
6.4 LV safety protocol, interlocking and communication 22
6.4.1 General 22
6.4.2 Operating of the low-voltage (LV) circuit-breakers and disconnectors 22
6.5 Shore connection convertor equipment 22
6.5.1 General 22
6.5.2 Cooling 23
6.5.3 Protection 23
7 Ship-to-shore connection and interface equipment 23
7.1 General 23
7.2 Cable management system 24
7.2.1 General 24

7.2.2 Monitoring of cable tension or position 25
7.2.3 Monitoring of the cable length 25
7.3 Ship and shore couplers 26
7.3.1 General 26
7.3.2 Safety loop scheme 27
7.3.3 Pilot contacts 30
7.4 Ship-to-shore connection cable 30
7.5 Storage 30
8 Ship-side installation 30
8.1 General 30
8.2 Ship electrical distribution system 30
8.2.1 Short-circuit protection 30
8.2.2 Earth fault protection, monitoring and alarm 30
8.2.3 Distribution system earthing 31
8.3 Shore connection switchboard 31
8.3.1 General 31
8.3.2 Ship-side main circuit-breaker 31
8.3.3 Instrumentation and protection 31
8.3.4 Operation of the circuit-breaker 32
8.4 Onboard transformer 32
8.5 Onboard main switchboard 33
8.5.1 General 33
8.5.2 Circuit-breaker 33
8.5.3 Instrumentation 33
8.5.4 Protection 34
8.5.5 Operation of the circuit-breaker 35
8.6 Ship power restoration 35
9 LVSC system control and monitoring 35
9.1 General requirements 35
9.2 Load transfer via blackout 35
9.3 Load transfer via automatic synchronization 36
9.3.1 General 36
9.3.2 Protection requirements 36
10 Verification and testing 36
10.1 General 36
10.2 Initial tests of shore-side installation 37
10.2.1 General 37
10.2.2 Tests 37
10.3 Initial tests of ship-side installation 37
10.3.1 General 37
10.3.2 Tests 37
10.4 Tests of the LVSC system at the first call 38
10.4.1 General 38
10.4.2 Tests 38
11 Periodic tests and maintenance 38
11.1 General 38
11.2 Tests and verification of the LVSC system at repeated calls 39
12 Documentation 39

12.1 General 39
12.2 System description 39
Annex A (informative) Shore-to-ship connection cable 40
A.1 General 40
A.2 Rated voltage 40
A.3 General design 40
A.3.1 General 40
A.3.2 Power and earth conductors 40
A.3.3 Pilot elements 41
A.3.4 Cabling 41
A.3.5 Separator tape 41
A.3.6 Outer sheath 42
A.3.7 Markings 42
A.4 Tests on complete cables 42
Annex B (normative) Ship-to-shore cable management and connector 44
B.1 General 44
Bibliography 46

Figure 1 – Block diagram of a typical LVSC system 12
Figure 2 – Phase sequence rotation – Positive direction 18
Figure 3 – Balanced three-phase variables in time domain 18
Figure 4 – Shore connection accessories 25
Figure 5 – Safety circuit 28
Figure A.1 – Bending test arrangement 43
Figure B.1 – Contact assignment 44

Table 1 – Number of parallel connections with the use of IEC 60309-5 26
Table B.1 – Connector types 44

Utility connections in port - Part 3: Low-voltage shore connection (LVSC) systems - General requirements

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.

   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.

   IEEE Standards documents are developed within IEEE Societies and subcommittees of IEEE Standards Association (IEEE SA) Board of Governors. IEEE develops its standards through an accredited consensus development process, which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE standards are documents developed by volunteers with scientific, academic, and industry-based expertise in technical working groups. Volunteers involved in technical working groups are not necessarily members of IEEE or IEEE SA and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

   IEC collaborates closely with ISO and IEEE in accordance with conditions determined by agreement between the organizations. This Triple Logo International Standard was jointly developed by the IEC, ISO and IEEE under the terms of that agreement.

2) The formal decisions 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. In the ISO, Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote. The formal decisions of IEEE on technical matters, once consensus within IEEE Societies and Standards Coordinating Committees has been reached, is determined by a balanced ballot of materially interested parties who indicate interest in reviewing the proposed standard. Final approval of the IEEE Standard document is given by the IEEE Standards Association (IEEE-SA) Standards Board.

3) IEC/ISO/IEEE Publications have the form of recommendations for international use and are accepted by IEC National Committees/ISO member bodies /IEEE Societies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC/ISO/IEEE Publications is accurate, IEC, ISO or IEEE 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 (including IEC/ISO/IEEE Publications) transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC/ISO/IEEE Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC, ISO and IEEE do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC, ISO and IEEE are 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, ISO or IEEE or their directors, employees, servants or agents including individual experts and members of technical committees and IEC National Committees and ISO member bodies, or volunteers of IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board, 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/ISO/IEEE Publication or any other IEC, ISO or IEEE 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 implementation of this IEC/ISO/IEEE Publication may require use of material covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. IEC, ISO or IEEE shall not be held responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patent Claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from ISO or the IEEE Standards Association.

IEC/IEEE 80005-3 was prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units, in cooperation with

– IEC subcommittee 23H: Plugs, socket-outlets and couplers for industrial and similar applications, and for electric vehicles, of IEC technical committee 23: Electrical accessories;
– ISO Technical Committee 8: Ships and marine technology, subcommittee 3: Piping and machinery;
– IEEE IAS Petroleum and Chemical Industry Committee (PCIC) of the IEEE Industry Applications Society.

This document is published as a triple logo (IEC, ISO and IEEE) standard.

This first edition cancels and replaces IEC PAS 80005-3:2014. This edition constitutes a technical revision.

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

Draft	Report on voting
18/1970/FDIS	18/1993A/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 8 members out of 8 having a cast vote.

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

This document was drafted in accordance with the rules given in the ISO/IEC Directives, Part 2, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications/.

A list of all the parts in the IEC 80005 series, published under the general title *Utility connections in port*, can be found on the IEC website.

The IEC Technical Committee and IEEE Technical Committee have 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, or
– revised.

INTRODUCTION

For a variety of reasons, including environmental considerations, it is becoming an increasingly common requirement for ships to shut down ship generators and to connect to shore power for as long as practicable during stays in port.

The intention of this document is to define requirements that support, with the application of suitable operating practices, efficiency and safety of connections by compliant ships to compliant low-voltage shore power supplies through a compatible shore-to-ship connection.

With the support of sufficient planning, cooperation between ship and terminal facilities, and appropriate operating procedures and assessment, compliance with the requirements of this document is intended to allow different ships to connect to low-voltage shore connection (LVSC) systems at different berths. This provides the benefits of standard, straightforward connection without the need for adaptation and adjustment at different locations that can satisfy the requirement to connect for as long as practicable during stays in port.

Ships that do not apply this document can find it impossible to connect to compliant shore supplies.

In relation to the 1 MVA upper scope limitation of this document, ship types that fall under the annexes of IEC/IEEE 80005-1 and require less than 1 MVA when connected to shore power can be designed in accordance with IEC/IEEE 80005-1 with a high-voltage shore connection to ensure interoperability.

Where deviations from the requirements and recommendations in this document are considered for certain designs, it is important to highlight the potential effects on compatibility.

Where the requirements and recommendations of this document are complied with, low-voltage shore supplies arrangements are likely to be compatible for visiting ships for connection.

Clauses 1 to 12 are intended for application to all LVSC systems. They intend to address mainly the safety and effectiveness of LVSC systems with a minimum level of requirements that would standardize on one solution.

This document includes the requirements to complete a detailed compatibility assessment for ship and shore supply prior to a ship arriving to connect to a shore supply for the first time.

Annex A includes cabling recommendations that can be used in LVSC systems and contains performance-based requirements for shore connection cables. Annex A was developed by technical experts from several countries. IEC technical committee 18, subcommittee 18A and IEC technical committee 20 were consulted regarding the cable requirements.

Annex B describes ship to shore cable management and connector to be used in LVSC systems.

1 Scope

This document specifies provisions for the design, installation and testing of low-voltage shore connection (LVSC) systems, onboard ships and on shore, to supply the ship with electrical power from shore.

This document is applicable to:

– ships requiring up to 1 MVA while at berth;
– three-phase shore connection systems rated 250 A and above, and with a nominal voltage rating of 400 V AC to 1 000 V AC;
– shore-side connection systems;
– shore-to-ship connection and interface equipment;
– transformers and reactors;
– semiconductor and rotating frequency convertors;
– ship-side connection systems;
– protection, control, monitoring, interlocking and power management systems.

This document does not apply to:

– inland navigation vessels;
– high-voltage shore connection systems, including ships built in accordance with the annexes of IEC/IEEE 80005-1;
– the electrical power supply during docking periods, for example dry docking and other out-of-service maintenance and repair;
– systems to be operated by ordinary persons as defined in 3.19.

NOTE 1 Other standards are available specifically for inland navigation vessels in Europe.

NOTE 2 IEC 60092-507 is applicable to small vessels.

NOTE 3 Additional or alternative requirements can be imposed by national administrations or the authorities within whose jurisdiction the ship is intended to operate and by the owners or authorities responsible for a shore power supply or distribution system.

NOTE 4 High-voltage shore connection systems are covered by IEC/IEEE 80005-1.

NOTE 5 Some existing 380 V AC ship systems can be supplied by 400 V AC.

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 60079 (all parts), *Explosive atmospheres*

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

IEC 60092-201:2019, *Electrical installations in ships - Part 201: System design - General*

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

IEC 60092-302-2, *Electrical installations in ships - Part 302-2: Low voltage switchgear and controlgear assemblies - Marine power*

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

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

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

IEC 60146 (all parts), *Semiconductor convertors - General requirements and line commutated convertors*

IEC 60309-1, *Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 1: General requirements*

IEC 60309-5:2017, *Plugs, socket-outlets and couplers for industrial purposes - Part 5: Dimensional compatibility and interchangeability requirements for plugs, socket-outlets, ship connectors and ship inlets for low-voltage shore connection systems (LVSC)*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-6*, Low-voltage electrical installations - Part 6: Verification*

IEC 60909 (all parts), *Short-circuit currents in three-phase AC systems*

IEC 60947-2, *Low-voltage switchgear and controlgear - Part 2: Circuit-breakers*

IEC 60947-5-1, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices*

IEC 61363-1, *Electrical installations of ships and mobile and fixed offshore units - Part 1: Procedures for calculating short-circuit currents in three-phase a.c.*

IEC 62477-1, *Safety requirements for power electronic converter systems and equipment - Part 1: General*

International Convention for the Safety of Life at Sea (SOLAS):1974, *Consolidated edition 2009, Ch. II-1/D, Regulations 42, 43 and 45*

3 Terms and definitions

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

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

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp
– IEEE Standards Dictionary Online: available at http://dictionary.ieee.org

3.1
cable management system
CMS
all equipment designed to control, monitor and deliver the flexible cables, for power and control, and their connection devices

3.2
shore plug and socket-outlet
means enabling the connection of a flexible cable to fixed wiring, consisting of a shore socket-outlet and a shore plug

Note 1 to entry For use of shore plugs, shore socket-outlets, and ship couplers, see Figure 4.

3.3
shore socket-outlet
part intended to be installed with the fixed wiring (shore side) or incorporated in equipment

Note 1 to entry: See Figure 4.

3.4
shore plug
part intended to be attached directly to one flexible cable, and to be connected to the shore socket-outlet

Note 1 to entry: See Figure 4.

3.5
ship coupler
means enabling the connection of a flexible cable to the ship, consisting of two parts: a ship connector and ship inlet

Note 1 to entry: See Figure 4.

3.6
ship connector
part intended to be attached to one flexible cable connected to the supply, and to be connected to the ship inlet

Note 1 to entry: See Figure 4.

3.7
ship inlet
part incorporated in, or fixed to, the ship

Note 1 to entry: See Figure 4.

3.8
equipotential bonding
set of electric connections intended to achieve equipotentiality between conductive parts

[SOURCE: IEC 60050-195:2021, 195-01-10]

3.9
low-voltage
LV
set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V AC

[SOURCE: IEC 60050-601:1985, 601-01-26, modified – In the definition, "for alternating current" has been replaced with "AC".]

3.10
person in charge
PIC
person or persons responsible for LVSC system operation

3.11
pilot contact
contact of the shore plug, ship inlet, shore socket-outlet and ship connector which signals correct connection, and which is a safety-related component

3.12
receiving point
connection point of the flexible cable on the ship

3.13
safe
condition in which safety risks are minimized to an acceptable level

[SOURCE: IEC/IEEE 80005-1:2019, 3.12]

3.14
fail-safe
able to enter or remain in a safe state in the event of a failure

[SOURCE: IEC 60050-821:2017, 821-01-10]

3.15
isolated system
system in which no live part is intentionally earthed, except for high impedance connections for protection or measurement purposes

[SOURCE: IEC 60050-195:2021, 195-04-07]

3.16
safety relay
device that will open the circuit even under single fault conditions

Note 1 to entry: This can be achieved by the series connection of two relays from different manufacturers or the application of similar technology.

3.17
safety circuit
normally closed interlocking circuit with pilot contacts and safety devices that shuts down the LVSC system in response to specific initiating events

3.18
load
power consumed by the ship while connected to shore power supply

3.19
ordinary person
person who is neither a skilled person nor an instructed person

[SOURCE: IEC 60050-195:2021, 195-04-03]

3.20
system earthing
system grounding, US
functional earthing and protective earthing of an electric system

[SOURCE: IEC 60050-195:2021, 195-01-14]

3.21
alarm
prioritized system of notification

Note 1 to entry: For IMO definitions, see IMO Resolution A.1021(26) Code of Alarms and Indicators.

3.22
exposed conductive part
conductive part of equipment that can be touched and that is not live under normal conditions, but that can become live when basic insulation fails

[SOURCE: IEC 60050-195:2021, 195-06-10]

4 General requirements

4.1 System description

A typical LVSC system in accordance with this document consists of hardware components as shown in Figure 1.