



IEC/IEEE 80005-1



Edition 2.1 2022-02
CONSOLIDATED VERSION

INTERNATIONAL STANDARD



**Utility connections in port –
Part 1: High voltage shore connection (HVSC) systems – General requirements**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC/ISO/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 Varembe
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 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 It also gives information on projects, replaced and withdrawn publications.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 Products & Services Portal - products.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 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

Preview generated by EVS



IEC/IEEE 80005-1



Edition 2.1 2022-02
CONSOLIDATED VERSION

INTERNATIONAL STANDARD



**Utility connections in port –
Part 1: High voltage shore connection (HVSC) systems – General requirements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 47.020.60

ISBN 978-2-8322-1074-2

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



REDLINE VERSION



Utility connections in port – Part 1: High voltage shore connection (HVSC) systems – General requirements

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	12
4 General requirements	13
4.1 System description.....	13
4.2 Distribution system	14
4.2.1 General	14
4.2.2 Equipotential bonding	14
4.3 Compatibility assessment before connection.....	15
4.4 HVSC system design and operation	15
4.4.1 System design.....	15
4.4.2 System operation.....	15
4.5 Personnel safety	16
4.6 Design requirements.....	16
4.6.1 General	16
4.6.2 Protection against moisture and condensation	16
4.6.3 Location and construction	16
4.6.4 Electrical equipment in areas where flammable gas or vapour and/or combustible dust can be present.....	17
4.7 Electrical requirements	17
4.8 System study and calculations	17
4.9 Emergency shutdown including emergency-stop facilities	18
5 HV shore supply system requirements	19
5.1 Voltages and frequencies.....	19
5.2 Quality of HV shore supply.....	20
6 Shore side installation	22
6.1 General.....	22
6.2 System component requirements	22
6.2.1 Circuit-breaker, disconnector and earthing switch	22
6.2.2 Transformer.....	22
6.2.3 Neutral earthing resistor	23
6.2.4 Equipment-earthing conductor bonding.....	23
6.3 Shore-to-ship electrical protection system.....	23
6.4 HV interlocking	24
6.4.1 General	24
6.4.2 Operating of the high-voltage (HV) circuit breakers, disconnectors and earthing switches.....	24
6.5 Shore connection convertor equipment	25
6.5.1 General	25
6.5.2 Degree of protection	25
6.5.3 Cooling.....	25
6.5.4 Protection.....	26
7 Ship-to-shore connection and interface equipment	26
7.1 General.....	26

7.2	Cable management system	26
7.2.1	General	26
7.2.2	Monitoring of cable mechanical tension	27
7.2.3	Monitoring of the cable length	27
7.2.4	Connectors protection	27
7.2.5	Equipotential bond monitoring	27
7.2.6	Slip ring units	28
7.3	Connectors	28
7.3.1	General	28
7.3.2	Pilot contacts	28
7.3.3	Earth contact	29
7.3.4	Fibre-optic connection	29
7.4	Interlocking of earthing switches	30
7.5	Ship-to-shore connection cable	30
7.6	Control and monitoring cable	31
7.7	Storage	31
7.8	Data communication	31
8	Ship requirements	31
8.1	General	31
8.2	Ship electrical distribution system protection	32
8.2.1	Short-circuit protection	32
8.2.2	Earth fault protection, monitoring and alarm	32
8.3	Shore connection switchboard	32
8.3.1	General	32
8.3.2	Circuit-breaker, disconnecter and earthing switch	32
8.3.3	Instrumentation and protection	33
8.4	Onboard transformer	33
8.5	Onboard receiving switchboard connection point	33
8.5.1	General	33
8.5.2	Circuit-breaker and earthing switch	33
8.5.3	Instrumentation	34
8.5.4	Protection	34
8.5.5	Operation of the circuit-breaker	35
8.6	Ship power restoration	35
9	HVSC system control and monitoring	36
9.1	General	36
9.2	Load transfer via blackout	36
9.3	Load transfer via automatic synchronization	36
9.3.1	General	36
9.3.2	Protection	37
10	Verification and testing	37
10.1	General	37
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	38
10.3.1	General	38
10.3.2	Tests	38
10.4	Tests at the first call at a shore supply point	38

10.4.1	General	38
10.4.2	Tests	38
11	Periodic tests and maintenance	39
11.1	General.....	39
11.2	Tests at repeated calls of a shore supply point	39
11.2.1	General	39
11.2.2	Verification	39
11.3	Earthing bonding connections	39
12	Documentation	40
12.1	General.....	40
12.2	System description.....	40
Annex A	(informative) Ship-to-shore connection cable	41
A.1	Rated voltage	41
A.2	General design	41
A.2.1	General	41
A.2.2	Conductors	41
A.2.3	Insulation of power cores and neutral core.....	41
A.2.4	Screening	42
A.2.5	Earth conductors	42
A.2.6	Pilot element with rated voltage $U_0/U (U_m) = 150/250 (300) V$	42
A.2.7	Optical fibres	43
A.2.8	Cabling	43
A.2.9	Separator tape.....	43
A.2.10	Outer sheath.....	43
A.2.11	Markings.....	43
A.3	Tests on complete cables	44
Annex B	(normative) Additional requirements for Roll-on Roll-off (Ro-Ro) cargo ships and Ro-Ro passenger ships	46
B.1	General.....	46
Annex C	(normative) Additional requirements for cruise ships.....	51
C.1	General.....	51
C.6	Shore side installation.....	56
Annex D	(normative) Additional requirements of container ships.....	59
D.1	General.....	59
Annex E	(informative) Additional requirements of liquefied natural gas carriers (LNGC).....	64
E.1	General.....	64
Annex F	(informative) Additional requirements for tankers	70
F.1	General.....	70
Bibliography	74
Figure 1	– Block diagram of a typical described HVSC system arrangement	14
Figure 2	– Phase sequences.....	20
Figure 3	– Single harmonic distortion limits.....	
Figure 4	– Fibre optic socket outlet.....	
Figure 5	– Fibre optic plug.....	
Figure A.1	– Bending test arrangement.....	45
Figure B.1	– General system diagram	47

Figure B.2 – Safety circuits	49
Figure B.3 – Three-phase plug ship connector and socket-outlet ship inlet contact assignment	50
Figure C.1 – General system diagram	51
Figure C.2 – Cruise ship HVSC system functional diagram	52
Figure C.3 – Safety and control circuits	55
Figure C.4 – Three-phase ship connector and ship inlet contact assignment.....	57
Figure C.5 – Three-phase ship inlet fitted with fail-safe limit switch.....	58
Figure D.1 – General system diagram	59
Figure D.2 – Safety circuits.....	61
Figure D.3 – Three-phase plug and socket-outlet contact assignment.....	62
Figure E.1 – General system diagram	65
Figure E.2 – Three-phase ship connector and ship inlet contact assignment.....	68
Figure F.1 – General system diagram	71
Figure F.2 – Three-phase shore plug ship connector and ship socket-outlet inlet contact assignment.....	73
Table E.1 – LNGC 140 000 m ³ to 225 000 m ³	66
Table E.2 – LNGC > 225 000 m ³	66

preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UTILITY CONNECTIONS IN PORT –

Part 1: High voltage shore connection (HVSC) 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 Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of IEEE and serve without compensation. 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 contained in its standards. Use of IEEE Standards documents is wholly voluntary. IEEE documents are made available for use subject to important notices and legal disclaimers (see <http://standards.ieee.org/IPR/disclaimers.html> for more information).

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.

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC/IEEE 80005-1 edition 2.1 contains the second edition (2019-03) [documents 18/1643/FDIS and 18/1657/RVD] and its amendment 1 (2022-02) [documents 18/1737/FDIS and 18/1754/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC/IEEE 80005-1 has been 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;
- and IEEE IAS Petroleum and Chemical Industry Committee (PCIC) of the Industry Applications Society of the IEEE.

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

This second edition constitutes a technical revision.

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

- a) modification of 4.1, Figure 1:
 - transformer on ship is optional, earthing switches on ship removed;
- b) modification of 4.2.2 and new item 11.3:
 - alternative procedure of periodic testing added;
- c) modification of 4.9:
 - minimum current value in the safety circuits shall be 50 mA;
 - opening of safety loop shall cause the automatic opening of ship and shore HVSC circuit breakers in a maximum time of 200 ms;
- d) modification of 5.2:
 - added Figure on harmonic contents;
- e) modification of 6.2.3:
 - earthing transformer with resistor can be used also on the secondary side;
 - neutral earthing resistor rating in amperes shall be minimum 25 A, 5 s;
- f) modification of all annexes:

- the safety circuits shall be mandatory;
- g) modification of A.2.1:
 - a metallic shield shall be installed at least on the power cores or common on pilot wires;
- h) modification of B.7.2.1:
 - new safety circuit introduced: single line diagram and description;
- i) modification of C.4.1:
 - SLD for cruise ships was updated, also the safety circuits to be coherent with main body, IEC symbols and introduced more details about the control socket-outlets and plugs manufacturer type;
- j) modification of C.7.3.1:
 - shore power connector pin assignment is updated;
 - all cruise ships shall use 4 cables in all cases;
- k) added D.6.1:
 - the supply point on shore can be fixed or movable;
- l) modification of D.7.3.2:
 - the voltage used in the pilot circuit for container ships shall be less than 60 V DC or 25 V AC.
- m) added D.8.6 and D.9.3.1:
 - automatic restart and synchronization alternatives;
- n) Annex E set to informative;
- o) Annex F set to informative.

Annexes use the same numbering as Clauses 1 to 12 with an annex letter prefix. Hence, the numbering is not necessarily continuous. Where no additional requirements are identified, the clause is not shown.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 publication and its amendment will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

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 scenario of receiving electrical power and other utilities from shore is historically known as "cold ironing".

The intention of this part of IEC/IEEE 80005 is to define requirements that support, with the application of suitable operating practices, efficiency and safety of connections by compliant ships to compliant high-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 high-voltage shore connections (HVSC) 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.

Where deviations from this document are considered, it is useful to note the effects of such deviations in the compatibility study.

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

Clauses 1 to 12 are intended for application to all HVSC systems. They intend to address mainly the safety and effectiveness of HVSC systems with a minimum level of requirements that would standardise on one solution. This document includes the requirement to complete a detailed compatibility assessment for each combination of ship and shore supply prior to a given ship arriving to connect to a given shore supply for the first time. This does not preclude the use of this document e.g. for safety purposes, such as for proprietary connection systems where a ship operates on dedicated routes.

Annex A includes cabling recommendations that should be used in HVSC systems.

The other annexes in this document are ship-specific annexes that include additional requirements related to agreed standardisation of solutions to achieve compatibility for compliant ships at different compliant berths and to address safety issues that are considered to be particular to that ship type.

Annex A is considered informative for the purposes of this document. Annex A contains performance-based requirements for shore connection cables and was developed by technical experts from a number of countries. IEC technical committee 18, subcommittee 18A and IEC technical committee 20 were consulted regarding cable requirements. It was determined that existing standards for cable can be used at this time and there is presently no need to develop a separate standard for shore connection cables.

UTILITY CONNECTIONS IN PORT –

Part 1: High voltage shore connection (HVSC) systems – General requirements

1 Scope

This part of IEC/IEEE 80005 describes high-voltage shore connection (HVSC) systems, onboard the ship and on shore, to supply the ship with electrical power from shore.

This document is applicable to the design, installation and testing of HVSC systems and addresses

- HV shore distribution systems,
- shore-to-ship connection and interface equipment,
- transformers/reactors,
- semiconductor/rotating frequency convertors,
- ship distribution systems, and
- control, monitoring, interlocking and power management systems.

It does not apply to the electrical power supply during docking periods, for example dry docking and other out of service maintenance and repair.

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

It is expected that HVSC systems will have practicable applications for ships requiring 1 MVA or more or ships with HV main supply.

Low-voltage shore connection systems are not covered by 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 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60076 (all parts), *Power transformers*

IEC 60079 (all parts), *Explosive atmospheres*

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

IEC 60092-201:1994, *Electrical installations in ships – Part 201: System design – General*

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

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 15 kV*

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

IEC 60146-1 (all parts), *Semiconductor convertors – General requirements and line commutated convertors*

IEC 60204-11:2000, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV*

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 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60502-2, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) – Part 2: Cables for rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)*

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 61936-1, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*

IEC 62271-200, *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 62613-1, *Plugs, socket-outlets and ship couplers for high-voltage shore connection systems (HVSC-Systems) – Part 1: General requirements*

IEC 62613-2:2016, *Plugs, socket-outlets and ship couplers for high-voltage shore connection systems (HVSC-Systems) – Part 2: Dimensional compatibility and interchangeability requirements for accessories to be used by various types of ships*

IEC/IEEE 80005-2, *Utility connections in port – Part 2: High and low voltage shore connection systems – Data communication for monitoring and control*

IEEE Std C37.20.2™, *Standard for Metal-Clad Switchgear*

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