IEC 61936-1

Edition 3.0 2021-07
COMMENTED VERSION

INTERNATIONAL STANDARD

colour inside

Power installations exceeding 1 kV AC and 1,5 kV DC – Part 1: AC

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Power installations exceeding 1 kV AC and 1,5 kV DC – Part 1: AC

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

POWER INSTALLATIONS EXCEEDING 1 kV AC AND 1,5 kV DC –

Part 1: ~~Common rules~~ AC

FOREWORD

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This commented version (CMV) of the official standard IEC 61936-1:2021 edition 3.0 allows the user to identify the changes made to the previous IEC 61936-1:2010+AMD1: 2014 CSV edition 2.1. Futhermore, comments from IEC TC 99 experts are provided to explain the reasons of the most relevant changes.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

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International Standard IEC 61936-1 has been prepared by IEC technical committee 99: Insulation co-ordination and system engineering of high voltage electrical power installations above 1,0 kV AC and 1,5 kV DC.

This third edition cancels and replaces the second edition published in 2010 and Amendment 1:2014. This edition constitutes a technical revision.

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

a) introduction has been rewritten to reflect the status when this document is produced;
b) the scope has been improved to clarify the application of this document;
c) missing and obsolete terms and definitions have been updated including improvement of existing terms;
d) Table 1 has been updated where agreements between supplier and user are needed;
e) requirements of electromagnetic compatibility have been clarified;
f) insulation coordination clause (Clause 5) has improved wording for better clarity and the technical content has an updated coordination to the latest versions of the insulation coordination standards;
g) wording regarding electrical equipment has been improved and made clearer;
h) subclause for fuses has been improved and reworded;
i) requirements have been added for labelling when multiple sources are required to be disconnected;
j) missing requirements for GIS have been reintroduced;
k) subclause regarding ventilation (HVAC) has been improved;
l) figures in Clause 7 have been updated and moved to the corresponding subclause;
m) requirements for transformer installations have been improved including adjustment of editorial typing-errors;
n) clause on protection, automation and auxiliary systems has been restructured and improved;
o) protection against lightning strokes has been extended;
p) clarification of content due to the distinction between erection (and providing electrical safety for the intended use of the electrical power installation) and subsequent activities such as maintenance and repair with safe working procedures;
q) where no provincial, national or regional regulations are available for safe working procedures, an informative guideline is provided in Annex F. This replaces the former parts of Figure 3 in Clause 7.

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

FDIS	Report on voting
99/311/FDIS	99/316/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.

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A list of all parts in the IEC 61936 series, published under the general title *Power installations exceeding 1 kV AC and 1,5 kV DC*, can be found on the IEC website.

A document on principles to be observed in the preparation of safety publications regarding high voltage installations is currently under development (IEC TS 61936-0).

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.

The reader's attention is drawn to the fact that Annex G lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

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INTRODUCTION

This part of IEC 61936 contains the minimum requirements for the design, erection, and verification of high voltage power installations greater than 1 kV AC. The rules are intended to provide for the safety of persons, livestock and property against dangers and damage which may arise in the reasonable use of such electrical installations and to provide for the proper functioning of those installations.

There are many provincial, national and regional laws, standards and internal rules dealing with the matter coming within the scope of this document regarding high voltage power installations. These practices have been taken as a basis for this work.

~~This part of IEC 61936 contains the minimum requirements valid for IEC countries and some additional information which ensures an acceptable reliability of an installation and its safe operation.~~

~~The publication of this standard is believed to be a decisive step towards the gradual alignment all over the world of the practices concerning the design and erection of high voltage power installations.~~

This third edition of IEC 61936-1, first published in 2001, follows worldwide feedback to improve clarity. It continues the effort to towards the alignment all over the world of practices concerning the design and erection of high voltage power installations.

Particular requirements for transmission and distribution installations, as well as particular requirements for power generation and industrial installations, are included in this document.

~~The relevant laws or regulations of an authority having jurisdiction takes precedence.~~

While national standards and regulations take precedence, jurisdictions may elect to adopt the requirements of this document.

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POWER INSTALLATIONS EXCEEDING 1 kV AC AND 1,5 kV DC –

Part 1: ~~Common rules~~ AC

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1 Scope

This part of IEC 61936 provides ~~common rules~~ requirements for the design and the erection of electrical power installations in systems with nominal voltages ~~above~~ exceeding 1 kV AC and nominal frequency up to and including 60 Hz, so as to provide safety and proper functioning for the use intended.

For the purpose of interpreting this document, an electrical power installation is considered to be one of the following:

a) substation, including substation for railway power supply;

b) electrical power installations on mast, pole and tower, switchgear and/or transformers located outside a closed electrical operating area;

c) one (or more) power station(s) located on a single site, the electrical power installation includes generators and transformers with all associated switchgear and all electrical auxiliary systems. Connections between generating stations located on different sites are excluded;

d) the electrical system of a factory, industrial plant or other industrial, agricultural, commercial or public premises;

e) electrical power installations ~~erected~~ on offshore ~~platforms~~ facilities for the purpose of generation, transmission, distribution and/or storage of electricity ~~e.g. offshore wind power farms~~; 1

f) transition towers/poles (between overhead lines and underground lines). 2

The electrical power installation includes, among others, the following equipment:

– rotating electrical machines;
– switchgear;
– transformers and reactors;
– converters;
– cables;
– wiring systems;
– batteries;
– capacitors;
– earthing systems;
– buildings and fences which are part of a closed electrical operating area;
– associated protection, control and auxiliary systems;
– large air core reactor.

NOTE 1 In general, ~~a standard for an item of~~ equipment standards take precedence over the requirements of this document.

This document does not apply to the design and erection of any of the following:

– overhead and underground lines between separate electrical power installations;

– ~~electric~~ electrified railway tracks and rolling stock; 3
– mining equipment and installations;
– fluorescent lamp installations;
– installations on ships according to IEC 60092 (all parts) and offshore units according to IEC 61892 (all parts), which are used in the offshore petroleum industry for drilling, processing and storage purposes;
– electrostatic equipment (e.g. electrostatic precipitators, spray-painting units);
– test sites;
– medical equipment, e.g. medical X-ray equipment.

This document does not apply to the design of prefabricated, type-tested switchgear and high voltage/low voltage prefabricated substation, for which separate IEC standards exist.

NOTE 2 The scope of this document does not ~~apply to~~ include the requirements for carrying out live working on electrical power installations. 4

NOTE 3 The scope of this document considers safety requirements for HV installations and the influences of HV installations on LV installations. ~~If not otherwise required in this standard,~~ For ~~low voltage~~ electrical installations up to 1 kV, IEC 60364 (all parts) applies.

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

~~IEC 60034-3, *Rotating electrical machines – Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines*~~

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

IEC 60071-1:2019, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2~~:1996~~, *Insulation co-ordination – Part 2: Application guidelines*

IEC 60076 (all parts), *Power transformers*

~~IEC 60076-2:1993, *Power transformers – Part 2: Temperature rise*~~

~~IEC 60076-11, *Power transformers – Part 11: Dry-type transformers*~~

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60079-10-2, *Explosive atmospheres – Part 10-2: Classification of areas –* ~~*Combustible*~~ *Explosive dust atmospheres*

IEC 60255 (all parts), *Measuring relays and protection equipment*

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IEC 60331-1, *Tests for electric cables under fire conditions – Circuit integrity – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm*

IEC 60331-21, *Tests for electric cables under fire conditions – Circuit integrity – Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6/1,0 kV*

IEC 60332 (all parts), *Tests on electric and optical fibre cables under fire conditions*

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

IEC~~/TS~~ 60479-1:~~2005~~2018, *Effects of current on human beings and livestock – Part 1: General aspects*

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

~~IEC 60617, *Graphical symbols for diagrams*~~

~~IEC 60721-2-6, *Classification of environmental conditions – Part 2-6: Environmental conditions appearing in nature – Earthquake vibration and shock*~~

~~IEC 60721-2-7, *Classification of environmental conditions – Part 2-7: Environmental conditions appearing in nature. Fauna and flora*~~

IEC 60754 (all parts), *Test on gases evolved during combustion of materials from cables*

~~IEC 60754-1, *Test on gases evolved during combustion of materials from cables – Part 1: Determination of the amount of halogen acid gas*~~

~~IEC 60754-2, *Test on gases evolved during combustion of electric cables – Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity*~~

IEC TS 60815-1, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

IEC TS 60815-2, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems*

IEC TS 60815-3, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems*

~~IEC 60826, *Design criteria of overhead transmission lines*~~

~~IEC 60865-1, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*~~

~~IEC 60909 (all parts), *Short-circuit currents in three-phase a.c. systems*~~

~~IEC 60949, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*~~

IEC TR 61000-5-2, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

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IEC 61034-1, *Measurement of smoke density of cables burning under defined conditions – Part 1: Test apparatus*

~~IEC 61082-1, *Preparation of documents used in electrotechnology – Part 1: Rules*~~

~~IEC 61100, *Classification of insulating liquids according of fire-point and net calorific value*~~

~~IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*~~

IEC 61219, *Live working – Earthing or earthing and short-circuiting equipment using lances as a short-circuiting device – Lance earthing*

IEC 61230, *Live working – Portable equipment for earthing or earthing and short-circuiting*

~~IEC 61243 (all parts), *Live working – Voltage detectors*~~

IEC TS 61463, *Bushings – Seismic qualification*

IEC 62271-1:~~2007~~2017, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear* ~~Amendment 1:2011~~

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 62271-201, *High-voltage switchgear and controlgear – Part 201: AC solid-insulation enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-202, *High-voltage switchgear and controlgear – Part 202: High-voltage/low-voltage prefabricated substation*

IEC 62271-203, *High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*

~~IEC 62271-206, *High-voltage switchgear and controlgear – Part 206: Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV*~~

IEC 62271-207, *High-voltage switchgear and controlgear – Part 207: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV*

IEC TR 62271-300, *High-voltage switchgear and controlgear – Part 300: Seismic qualification of alternating current circuit-breakers*

~~IEC/TR 62271-303, *High-voltage switchgear and controlgear – Part 303: Use and handling of sulphur hexafluoride (SF_6)*~~

IEC 62305 (all parts), *Protection against lightning*

~~IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*~~

~~IEC 82079-1, *Preparation of instructions for use – Structuring, content and presentation – Part 1: General principles and detailed requirements*~~

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IEC/IEEE 82079-1, *Preparation of information for use (instructions for use) of products – Part 1: Principles and general requirements*

~~IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*~~

~~ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*~~

~~ISO 1996-1, *Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*~~

~~IEEE 80, *Guide for safety in AC substation grounding*~~

~~IEEE 980, *Guide for containment and control of oil spills in substations*~~

~~Official Journal of the European Communities, No. C 62/23 dated 28.2.1994: *Interpretative document, Essential requirements No. 2, "safety in case of fire"*~~

3 Terms and definitions

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

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

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

3.1 General definitions

3.1.1
electrical equipment
item used for such purposes as generation, conversion, transmission, distribution or utilization of electric energy, such as electric machines, transformers, switchgear and controlgear, measuring instruments, protective devices, wiring systems, current-using equipment

[SOURCE: IEC 60050-826:2004, 826-16-01, modified – In the term, "electric" has been replaced by "electrical".]

3.1.2
nominal value
value of a quantity used to designate and identify a component, device, equipment or system

[SOURCE: IEC 60050-151:2001, 151-16-09, modified – The note has been removed.]

~~**3.1.3**~~
~~**nominal voltage of a system**~~
~~suitable approximate value of voltage used to designate or identify a system~~

~~[IEC 60050-601:1985, 601-01-21]~~

3.1.3
rated value
value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment, or system

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