IEC 60071-2

Edition 5.0 2023-05
REDLINE VERSION

INTERNATIONAL STANDARD

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HORIZONTAL PUBLICATION

Insulation co-ordination –
Part 2: Application guidelines

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INTERNATIONAL
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FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60071-2:2018. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60071-2 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. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2018. This edition constitutes a technical revision.

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

a) Clause 4 Concepts governing the insulation co-ordination has been added.
b) Subclause 5.3 has been revised, and Subclause 5.4 Detailed simulation has been added because it is widely applied in the recent practices of insulation coordination.
c) Special considerations for cable line and GIL/GIB have been added in Clause 9.
d) Annex K (informative) Application of line shunt reactor to limitation of TOV and SFO in high voltage overhead transmission lines has been added.
e) Annex L (informative) Calculation of lightning stroke rate and lightning outage rate has been added.

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

Draft	Report on voting
99/356/CDV	99/392/RVC

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/publications.

A list of all parts in the IEC 60071 series, published under the general title *Insulation co-ordination*, 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.

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

INSULATION CO-ORDINATION –

Part 2: Application guidelines

1 Scope

This part of IEC 60071 constitutes application guidelines and deals with the selection of insulation levels of equipment or installations for three-phase ~~electrical~~ AC systems. Its aim is to give guidance for the determination of the rated withstand voltages for ranges I and II of IEC 60071-1 and to justify the association of these rated values with the standardized highest voltages for equipment.

This association is for insulation co-ordination purposes only. The requirements for human safety are not covered by this document.

This document covers three-phase AC systems with nominal voltages above 1 kV. The values derived or proposed herein are generally applicable only to such systems. However, the concepts presented are also valid for two-phase or single-phase systems.

This document covers phase-to-earth, phase-to-phase and longitudinal insulation.

This document is not intended to deal with routine tests. These are to be specified by the relevant product committees.

The content of this document strictly follows the flow chart of the insulation co-ordination process presented in Figure 1 of IEC 60071-1:~~2006~~2019. Clauses 5 to 8 correspond to the squares in this flow chart and give detailed information on the concepts governing the insulation co-ordination process which leads to the establishment of the required withstand levels.

This document emphasizes ~~the necessity of considering~~ to consider, at the very beginning, all origins, all classes and all types of voltage stresses in service irrespective of the range of highest voltage for equipment. Only at the end of the process, when the selection of the standard withstand voltages takes place, does the principle of covering a particular service voltage stress by a standard withstand voltage apply. Also, at this final step, this document refers to the correlation made in IEC 60071-1 between the standard insulation levels and the highest voltage for equipment.

The annexes contain examples and detailed information which explain or support the concepts described in the main text, and the basic analytical techniques used.

It has the status of a horizontal standard in accordance with IEC Guide 108.

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 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60071-1:~~2006~~2019, *Insulation co-ordination – Part 1: Definitions, principles and rules* ~~IEC 60071-1:2006/AMD1:2010~~

IEC 60505:2011, *Evaluation and qualification of electrical insulation systems*

IEC TS 60815-1:2008, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

~~ISO 2533:1975, *Standard Atmosphere*~~

IEC TR 60071-4:2004, *Insulation co-ordination – Part 4: Computational guide to insulation co-ordination and modelling of electrical networks*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

~~No terms and definitions are listed in this document.~~

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

ISO and IEC 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

3.1.1
insulation co-ordination
selection of the dielectric strength of equipment in relation to the operating voltages and overvoltages which can appear on the system for which the equipment is intended and taking into account the service environment and the characteristics of the available preventing and protective devices

Note 1 to entry: By "dielectric strength" of the equipment, is meant here its rated or its standard insulation level as defined in 3.36 and 3.37 of 60071-1:2019 respectively.

[IEC 60071-1:2019, 3.1]

3.1.2
earth fault factor
at a given location of a three-phase system, and for a given system configuration, the ratio of the highest RMS phase-to-earth power-frequency voltage on a healthy phase during a fault to earth affecting one or more phases at any point on the system to the RMS phase-to-earth power-frequency voltage which would be obtained at the given location in the absence of any such fault

[SOURCE: IEC 60071-1:2019, 3.15]

3.2 Abbreviated terms

AIS	air-insulated substation
EGLA	externally gapped line arrester
EHV	extra high voltage: the highest voltage for equipment above 245 kV and up to and including 800 kV
EMT	electro-magnetic transients
ESDD	equivalent salt deposit density

FFO	fast-front overvoltage
GIS	gas-insulated switchgear, gas-insulated substation
LIPL	lightning impulse protection level
LIWV	lightning impulse withstand voltage
LSA	line surge arrester
MOSA	metal-oxide surge arrester
MTBF	mean time between failure
NGLA	non-gapped line arrester
SDWV	short-duration power-frequency withstand voltage
SFO	slow-front overvoltage
SIPL	switching impulse protection level
SIWV	switching impulse withstand voltage
SVU	series varistor unit
TCV	trapped charge voltage
TOV	temporary ~~power-frequency~~ overvoltages
UHV	ultra high voltage: the highest voltage for equipment above 800 kV
VFFO	very-fast-front overvoltage

3.3 Symbols

For the purposes of this document, the following symbols and definitions apply. The symbol is followed by the unit to be normally considered, dimensionless quantities being indicated by (-).

Some quantities are expressed in p.u. A per unit quantity is the ratio of the actual value of an electrical parameter (voltage, current, frequency, power, impedance, etc.) to a given reference value of the same parameter.

A	(kV)	parameter characterizing the influence of the lightning severity for the equipment depending on the type of overhead line connected to it
a_1	(m)	length of the lead connecting the surge arrester to the line
a_2	(m)	length of the lead connecting the surge arrester to earth
a_3	(m)	length of the phase conductor between the surge arrester and the protected equipment
a_4	(m)	length of the active part of the surge arrester
B	(-)	factor used when describing the phase-to-phase discharge characteristic
C_e	(nF)	capacitance to earth of transformer primary windings
C_s	(nF)	series capacitance of transformer primary windings
C_2	(nF)	phase-to-earth capacitance of the transformer secondary winding
C_{12}	(nF)	capacitance between primary and secondary windings of transformers
C_{1in}	(nF)	equivalent input capacitance of the terminal 1 of three-phase transformers
C_{2in}	(nF)	equivalent input capacitance of the terminal 2 of three-phase transformers
C_{3in}	(nF)	equivalent input capacitance of the terminal 3 of three-phase transformers