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Insulation co-ordination – Part 2: Application guidelines

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INSULATION CO-ORDINATION –

Part 2: Application guidelines

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.
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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.

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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*

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Coordination de l'isolement – Partie 2: Lignes directrices en matière d'application



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INSULATION CO-ORDINATION –

Part 2: Application guidelines

FOREWORD

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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.

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

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*

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

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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COORDINATION DE L'ISOLEMENT –

Partie 2: Lignes directrices en matière d'application

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Cette cinquième édition annule et remplace la quatrième édition parue en 2018. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) l'Article 4, Concepts applicables à la coordination de l'isolement, a été ajouté;
b) le 5.3 a été révisé et le 5.4, Simulation détaillée, a été ajouté, car la simulation est largement appliquée dans les récentes pratiques de coordination de l'isolement;

c) des points particuliers ont été ajoutés pour les câbles et pour les lignes de transport/barres blindées à isolation gazeuse à l'Article 9;

d) l'Annexe K (informative), Application d'une inductance shunt pour la limitation des TOV et des SFO dans les lignes de transport aériennes à haute tension, a été ajoutée;

e) l'Annexe L (informative), Calcul du taux de foudroiement et du taux de coupure due à la foudre, a été ajoutée.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
99/356/CDV	99/392/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 60071, publiées sous le titre général *Coordination de l'isolement*, se trouve sur le site web de l'IEC.

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COORDINATION DE L'ISOLEMENT –

Partie 2: Lignes directrices en matière d'application

1 Domaine d'application

La présente partie de l'IEC 60071 constitue des lignes directrices en matière d'application et concerne le choix des niveaux d'isolement des matériels ou des installations pour les réseaux triphasés en courant alternatif. Elle a pour objet de donner des recommandations pour la détermination des tensions de tenue assignées pour les plages I et II de l'IEC 60071-1 et de justifier l'association de ces valeurs assignées avec les valeurs normalisées des tensions les plus élevées pour le matériel.

Cette association ne couvre que les besoins de la coordination de l'isolement. Les exigences relatives à la sécurité des personnes ne sont pas traitées dans le présent document.

Le présent document traite des réseaux triphasés en courant alternatif de tension nominale supérieure à 1 kV. Les valeurs déduites ou qui y sont proposées ne s'appliquent généralement qu'à ces seuls réseaux. Cependant, les principes présentés sont également valables pour les réseaux biphasés ou monophasés.

Le présent document traite de l'isolement phase-terre, entre phases et longitudinal.

Le présent document n'est pas destiné à traiter des essais individuels de série. Ces essais doivent être spécifiés par les comités de produit concernés.

Le contenu du présent document suit strictement l'organigramme de la procédure de coordination de l'isolement représenté à la Figure 1 de l'IEC 60071-1:2019. Les Articles 5 à 8 correspondent à chacun des rectangles de l'organigramme et donnent des informations détaillées sur les principes de la procédure de coordination de l'isolement qui conduit à déterminer les niveaux de tenue spécifiés.

Le présent document insiste sur la prise en considération, dès le départ, de toutes les origines, toutes les classes et tous les types de contraintes de tension en service quelle que soit la plage de la tension la plus élevée pour le matériel. Ce n'est qu'à la fin de la procédure, au moment de sélectionner les tensions de tenue normalisées, que le principe de couvrir une contrainte de tension particulière en service par une tension de tenue normalisée est appliqué. De même, le document fait référence, à cette étape finale, aux corrélations établies dans l'IEC 60071-1 entre les niveaux d'isolement normalisés et la tension la plus élevée pour le matériel.

Les annexes contiennent des exemples et des informations détaillées qui expliquent ou corroborent les principes décrits dans le texte principal, et les techniques analytiques de base qui sont utilisées.

Le présent document a le statut d'une norme horizontale conformément au Guide 108 de l'IEC.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60060-1:2010, *Techniques des essais à haute tension – Partie 1: Définitions et exigences générales*

IEC 60071-1:2019, *Coordination de l'isolement – Partie 1: Définitions, principes et règles*

IEC 60505:2011, *Évaluation et qualification des systèmes d'isolation électrique*

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* (disponible en anglais seulement)

IEC TR 60071-4:2004, *Insulation co-ordination – Part 4: Computational guide to insulation co-ordination and modelling of electrical networks* (disponible en anglais seulement)