

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Coordination de l'isolement –
Partie 1: Définitions, principes et règles**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2006 IEC, Geneva, Switzerland

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 either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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 corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00



INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Coordination de l'isolement –
Partie 1: Définitions, principes et règles**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions.....	7
4 Symbols and abbreviations.....	14
4.1 General.....	14
4.2 Subscripts.....	14
4.3 Letter symbols.....	14
4.4 Abbreviations.....	15
5 Procedure for insulation co-ordination.....	15
5.1 General outline of the procedure.....	15
5.2 Determination of the representative voltages and overvoltages (U_{rp}).....	17
5.3 Determination of the co-ordination withstand voltages (U_{cw}).....	18
5.4 Determination of the required withstand voltage (U_{rw}).....	19
5.5 Selection of the rated insulation level.....	19
5.6 List of standard rated short-duration power frequency withstand voltages.....	20
5.7 List of standard rated impulse withstand voltages.....	20
5.8 Ranges for highest voltage for equipment.....	20
5.9 Environmental conditions.....	21
5.10 Selection of the standard insulation level.....	21
5.11 Background of the standard insulation levels.....	25
6 Requirements for standard withstand voltage tests.....	26
6.1 General requirements.....	26
6.2 Standard short-duration power-frequency withstand voltage tests.....	27
6.3 Standard impulse withstand voltage tests.....	27
6.4 Alternative test situation.....	28
6.5 Phase-to-phase and longitudinal insulation standard withstand voltage tests for equipment in range I.....	28
6.6 Phase-to-phase and longitudinal insulation standard withstand voltage tests for equipment in range II.....	29
Annex A (normative) Clearances in air to assure a specified impulse withstand voltage installation.....	30
Annex B (informative) Values of rated insulation levels for $1\text{ kV} < U_m \leq 245\text{ kV}$ for highest voltages for equipment U_m not standardized by IEC based on current practice in some countries.....	34
Bibliography.....	35
Figure 1 – Flow chart for the determination of rated or standard insulation level.....	16

Table 1 – Classes and shapes of overvoltages, Standard voltage shapes and Standard withstand voltage tests	17
Table 2 – Standard insulation levels for range I ($1\text{kV} < U_m \leq 245\text{ kV}$).....	23
Table 3 – Standard insulation levels for range II ($U_m > 245\text{ kV}$)	24
Table A.1 – Correlation between standard rated lightning impulse withstand voltages and minimum air clearances	31
Table A.2 – Correlation between standard rated switching impulse withstand voltages and minimum phase-to-earth air clearances.....	32
Table A.3 – Correlation between standard rated switching impulse withstand voltages and minimum phase-to-phase air clearances	33
Table B.1- Values of rated insulation levels for $1\text{kV} < U_m \leq 245\text{ kV}$ for highest voltages for equipment U_m not standardized by IEC based on current practice in some countries	34

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSULATION CO-ORDINATION –

Part 1: Definitions, principles and rules

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.
- 2) The formal decisions or agreements 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.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC 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 transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees 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 Publication or any other IEC 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 some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60071-1 has been prepared by IEC technical committee 28: Insulation co-ordination.

This eighth edition cancels and replaces the seventh edition published in 1993 and constitutes a technical revision.

The main changes from the previous edition are as follows:

- in the definitions (3.26, 3.28 and 3.29) and in the environmental conditions (5.9) taken into account clarification of the atmospheric and altitude corrections involved in the insulation co-ordination process;
- in the list of standard rated short-duration power frequency withstand voltages reported in 5.6 addition of 115 kV;

- in the list of standard rated impulse withstand voltages reported in 5.7, addition of 200 kV and 380 kV;
- in the standard insulation levels for range I ($1\text{ kV} < U_m \leq 245\text{ kV}$) (Table 2) addition of the highest voltage for equipment $U_m = 100\text{ kV}$;
- in the standard insulation levels for range II ($U_m > 245\text{ kV}$) (Table 3) replacement of 525 kV by 550 kV and of 765 kV by 800 kV;
- in order to remove that part in the next revision of IEC 60071-2, addition of Annex A dealing with clearances in air to assure a specified impulse withstand voltage in installation;
- in Annex B, limitation at two U_m values for the values of rated insulation levels for $1\text{ kV} < U_m \leq 245\text{ kV}$ for highest voltages for equipment U_m not standardized by IEC based on current practice in some countries.

The text of this standard is based on the following documents:

FDIS	Report on voting
28/176/FDIS	28/177/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The IEC 60071 comprises the following parts under the general title *Insulation co-ordination*:

Part 1: Definitions, principles and rules

Part 2: Application guide

Part 4: Computational guide to insulation co-ordination and modelling of electrical networks

Part 5: Procedures for high-voltage direct current (HVDC) converter stations

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site 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.

INSULATION CO-ORDINATION –

Part 1: Definitions, principles and rules

1 Scope

This part of IEC 60071 applies to three-phase a.c. systems having a highest voltage for equipment above 1 kV. It specifies the procedure for the selection of the rated withstand voltages for the phase-to-earth, phase-to-phase and longitudinal insulation of the equipment and the installations of these systems. It also gives the lists of the standard withstand voltages from which the rated withstand voltages should be selected.

This standard recommends that the selected withstand voltages should be associated with the highest voltage for equipment. This association is for insulation co-ordination purposes only. The requirements for human safety are not covered by this standard.

Although the principles of this standard also apply to transmission line insulation, the values of their withstand voltages may be different from the standard rated withstand voltages.

The apparatus committees are responsible for specifying the rated withstand voltages and the test procedures suitable for the relevant equipment taking into consideration the recommendations of this standard.

NOTE In IEC 60071-2, Application Guide, all rules for insulation co-ordination given in this standard are justified in detail, in particular the association of the standard rated withstand voltages with the highest voltage for equipment. When more than one set of standard rated withstand voltages is associated with the same highest voltage for equipment, guidance is provided for the selection of the most suitable set.

2 Normative references

The following referenced documents are indispensable for the application 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 60038:2002, *IEC standard voltages*

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60071-2, *Insulation co-ordination – Part 2: Application guide*

IEC 60099-4, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*

IEC 60507, *Artificial pollution tests on high-voltage insulators to be used on a.c. systems*

IEC 60633, *Terminology for high-voltage direct current (HVDC) transmission*