IEC TS 62993

Edition 1.0 2017-07

TECHNICAL SPECIFICATION

Guidance for determination of clearances, creepage distances and requirements for solid insulation for equipment with a rated voltage above 1 000 V AC and 1 500 V DC, and up to 2 000 V AC and 3 000 V DC

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.080.30

ISBN 978-2-8322-4501-9

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

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 8
4 Basic information for the determination of INSULATION requirements 11
4.1 General 11
4.2 Voltages 12
4.2.1 General 12
4.2.2 Determination of RECURRING PEAK VOLTAGE 12
4.3 OVERVOLTAGE categories 12
4.4 Material groups 13
4.5 POLLUTION DEGREES 14
4.5.1 General 14
4.5.2 Degrees of POLLUTION in the MICRO-ENVIRONMENT 14
4.5.3 Conditions of conductive POLLUTION 14
4.5.4 Clearances 14
5 Dimensioning rules 15
5.1 Clearances 15
5.2 CREEPAGE DISTANCES 17
5.2.1 General 17
5.2.2 Voltage 17
5.2.3 POLLUTION 17
5.2.4 Shape of insulating surface 17
5.2.5 Relationship to CLEARANCE 18
5.2.6 CREEPAGE DISTANCES where more than one material is used or more than one POLLUTION DEGREE occurs 18
5.2.7 CREEPAGE DISTANCES split by floating conductive part 18
5.2.8 Dimensioning of CREEPAGE DISTANCES of BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION 19
5.2.9 CREEPAGE DISTANCES for DC applications 20
5.3 SOLID INSULATION 21
5.3.1 General 21
5.3.2 Withstand of voltage stresses 21
6 Tests and measurements 21
6.1 Tests 21
6.1.1 General 21
6.1.2 Test for verification of CLEARANCES 22
6.1.3 Tests for the verification of SOLID INSULATION 24
6.2 Measuring CLEARANCES and CREEPAGE DISTANCES 27
Bibliography 28

Figure 1 – RECURRING PEAK VOLTAGE 12
Figure 2 – Determination of the width (W) and height (H) of a rib 18

Table 1 – RATED IMPULSE VOLTAGES according to OVERVOLTAGE CATEGORIES 13

Table 2 – Clearances to withstand TRANSIENT OVERVOLTAGES 15
Table 3 – Dimensioning of clearances to WORKING VOLTAGES, TEMPORARY OVERVOLTAGES or RECURRING PEAK VOLTAGES 16
Table 4 – Altitude correction factors 17
Table 5 – CREEPAGE DISTANCES to avoid failure due to tracking 20
Table 6 – Test voltages based on CLEARANCES and a test site altitude of 2 000 m above sea level 23
Table 7 – Correction factors according to test site altitude for test voltages for CLEARANCES 24
Table 8 – Severities for conditioning of SOLID INSULATION 26

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

GUIDANCE FOR DETERMINATION OF CLEARANCES, CREEPAGE DISTANCES AND REQUIREMENTS FOR SOLID INSULATION FOR EQUIPMENT WITH A RATED VOLTAGE ABOVE 1 000 V AC AND 1 500 V DC, AND UP TO 2 000 V AC AND 3 000 V DC

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 itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is 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 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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62993, which is a technical specification, has been prepared by IEC technical committee 109: Insulation co-ordination for low-voltage equipment.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
109/158A/DTS	109/162/RVDTS

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

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

In this standard, the following print types are used:

– requirements: in roman type;

– NOTES: in small roman type;

– *conformity and tests: in italic type;*

– terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS.

The committee has decided that the contents of this publication 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

IEC TS 62993 is developed in a JWG between several interested committees: TC 9, SC 22G, TC 31, TC 66, TC 82, SC 121A, and ACOS under the leadership of TC 109.

This document provides additional steps for a smooth transition between the low voltage (up to 1 000 V AC and 1 500 V DC) in IEC 60664 (all parts) and high voltage insulation coordination (although IEC 60071-1 is applicable from above 1 000 V, it only gives values starting at 3 600 V). IEC 60071-1 states that it does not cover the requirements for human safety. Moreover IEC 60071-1 does not provide values for creepage distances.

This document has been requested by several TCs dealing with equipment with a rated voltage above 1 000 V AC and 1 500 V DC up to 2 000 V AC and 3 000 VDC.

It is not the intention to extend the limit of low voltage range – having a conventionally accepted limit of 1 000 V AC and 1 500 V DC – into the high voltage range.

GUIDANCE FOR DETERMINATION OF CLEARANCES, CREEPAGE DISTANCES AND REQUIREMENTS FOR SOLID INSULATION FOR EQUIPMENT WITH A RATED VOLTAGE ABOVE 1 000 V AC AND 1 500 V DC, AND UP TO 2 000 V AC AND 3 000 V DC

1 Scope

IEC TS 62993, which is a Technical Specification, gives guidance to technical committees which deal with equipment having a RATED VOLTAGE of more than 1 000 V AC and up to 2 000 V AC, or a RATED VOLTAGE of more than 1 500 V DC and up to 3 000 V DC. RATED VOLTAGES up to 1 000 V AC and 1 500 V DC, as well as higher or lower internal voltages, are covered by IEC 60664-1.

This document applies to equipment for use up to 2 000 m above sea level, and provides guidance for use at higher altitudes.

This document gives guidance for CLEARANCES, CREEPAGE DISTANCES and SOLID INSULATION for equipment to achieve safety. It includes methods of electric testing.

NOTE Requirements for functional insulation are not specified as they are not regarded as safety requirements.

This document does not deal with distances

- through liquid insulation,
- through gases other than air, and
- through compressed air.

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 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*
IEC 60112:2003/AMD1:2009

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*