

# 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

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# TECHNICAL SPECIFICATION

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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**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**

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- 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- withdrawn,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.

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

The contents of the corrigendum of June 2018 have been included in this copy.

## 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.

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# 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 [IEC TS 62993:2017](https://standards.iteh.ai/catalog/standards/sist/b03480bb-4c47-455b-981f-37ed093d469e/iec-ts-62993-2017)
- 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*

### 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

##### **CLEARANCE**

shortest distance in air between two conductive parts

[SOURCE: IEC 60050-581:2008, 581-27-76]

#### 3.2

##### **CREEPAGE DISTANCE**

shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50]

#### 3.3

##### **SOLID INSULATION**

solid insulating material, or a combination of solid insulating materials, placed between two conductive parts or between a conductive part and a body part

[SOURCE: IEC 60050-903:2015, 903-04-14]

#### 3.4

##### **WORKING VOLTAGE**

highest RMS value of the AC or DC voltage across any particular insulation which can occur when the equipment is supplied at RATED VOLTAGE

[SOURCE: IEC 60050-581:2008, 581-21-19]

#### 3.5

##### **RECURRING PEAK VOLTAGE**

maximum peak value of periodic excursions of the voltage waveform resulting from distortions of an AC voltage or from AC components superimposed on a DC voltage

[SOURCE: IEC 60050-442:2014, 442-09-15, modified – The note to entry has been deleted.]

#### 3.6

##### **OVERVOLTAGE**

voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

[SOURCE: IEC 60664-1:2007, 3.7]

#### 3.7

##### **TEMPORARY OVERVOLTAGE**

power frequency OVERVOLTAGE of relatively long duration

[SOURCE: IEC 60050-614:2016, 614-03-13, modified – The note to entry has been deleted.]

**3.8****TRANSIENT OVERVOLTAGE**

OVERVOLTAGE with a duration of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

[SOURCE: IEC 60050-614:2016, 604-03-14]

**3.9****WITHSTAND VOLTAGE**

value of the test voltage to be applied under specified conditions in a withstand test, during which disruptive discharges are not tolerated

**3.10****IMPULSE WITHSTAND VOLTAGE**

highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60050-442:2014, 442-09-18]

**3.11****RATED VOLTAGE**

rated value of voltage assigned by the manufacturer, to a component, device or equipment and to which operation and performance characteristics are referred

Note 1 to entry Equipment may have more than one RATED VOLTAGE value or may have a RATED VOLTAGE range.

Note 2 to entry For three-phase power supply, the line-to-line voltage applies.

[SOURCE: IEC 60050-442:2014, 442-09-10]

**3.12****RATED INSULATION VOLTAGE**

rated value of the RMS WITHSTAND VOLTAGE assigned by the manufacturer to the equipment or to a part of it, characterizing the specified (long-term) withstand capability of its insulation

Note 1 to entry The RATED INSULATION VOLTAGE is not necessarily equal to the RATED VOLTAGE of equipment which is primarily related to functional performance.

[SOURCE: IEC 60050-312:2014, 312-06-02]

**3.13****RATED IMPULSE VOLTAGE**

IMPULSE WITHSTAND VOLTAGE value assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against TRANSIENT OVERVOLTAGES

**3.14****OVERVOLTAGE CATEGORY**

numeral defining a TRANSIENT OVERVOLTAGE condition

[SOURCE: IEC 60050-581:2008, 581-21-02]

**3.15****POLLUTION**

any addition of foreign matter, solid, liquid, or gaseous that can produce a permanent reduction of electric strength or surface resistivity of the insulation

[SOURCE: IEC 60050-442:1998, 442-01-28]

**3.16****POLLUTION DEGREE**

numeral characterizing the expected POLLUTION of the MICRO-ENVIRONMENT

[SOURCE: IEC 60050-581:2008, 581-21-07, modified – The note to entry has been deleted.]

**3.17****ENVIRONMENT**

surroundings in which a product or system exists, including air, water, land, natural resources, flora, fauna, humans and their interrelation

[SOURCE: IEC 60050-901:2013, 901-07-01]

**3.18****MICRO-ENVIRONMENT**

ambient conditions which immediately surround the CLEARANCE and CREEPAGE DISTANCE under consideration excluding self-produced POLLUTION resulting from normal operation of the accessory

Note 1 to entry The MICRO-ENVIRONMENT of the CREEPAGE DISTANCE or CLEARANCE and not the ENVIRONMENT of the accessory determines the effect on the insulation. It might be better or worse than the ENVIRONMENT of the accessory.

[SOURCE: IEC 60050-442:1998, 442-01-29]

**iTeh STANDARD PREVIEW****3.19****HOMOGENEOUS ELECTRIC FIELD (standards.iteh.ai)**

electric field which has an essentially constant voltage gradient between electrodes (uniform field), such as that between two spheres where the radius of each sphere is greater than the distance between them

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Note 1 to entry The HOMOGENEOUS ELECTRIC FIELD condition is referred to as case B.

[SOURCE: IEC 60050-442:2014, 442-09-02.]

**3.20****INHOMOGENEOUS ELECTRIC FIELD**

electric field which does not have an essentially constant voltage gradient between electrodes (non-uniform field)

Note 1 to entry The INHOMOGENEOUS ELECTRIC FIELD condition of a point-plane electrode configuration is the worst case with regard to voltage withstand capability and is referred to as case A. It is represented by a point electrode having a 30 µm radius and a plane of 1 m x 1 m.

[SOURCE: IEC 60050-442:2014, 442-09-03,.]

**3.21****INSULATION**

part of an electrotechnical product which separates the conducting parts at different electrical potentials

[SOURCE: IEC 60050-212:2010, 212-11-07,]

**3.22****BASIC INSULATION**

INSULATION of hazardous-live-parts which provides basic protection

Note 1 to entry The concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-826:2004, 826-12-14]