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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment

Applications ferroviaires – Coordination de l'isolement – Partie 1: Exigences fondamentales – Distances d'isolement dans l'air et lignes de fuite pour tout matériel électrique et électronique

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS – INSULATION COORDINATION –

Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment

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IEC 62497-1 edition 1.1 contains the first edition (2010) [documents 9/1335/FDIS and 9/1358/RVD] and its amendment 1 (2013) [documents 9/1758/FDIS and 9/1782/RVD].

A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 62497-1 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This standard is based on EN 50124-1.

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

A list of all parts of IEC 62497, under the general title *Railway applications – Insulation coordination*, can be found of the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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- withdrawn,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.

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

INTRODUCTION

Special conditions occurring in railway applications and the fact that the equipment here concerned falls into the scope of both IEC 60071 (prepared by IEC technical committee 28) and IEC 60664-1 (prepared by IEC technical committee 109), led to the decision to draw from these documents and from IEC 60077-1 (prepared by IEC technical committee 9), a single document of reference for all standards applicable to the whole railway field.

IEC 62497 consists of two parts:

– IEC 62497-1: Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment;

– IEC 62497-2: Part 2: Overvoltages and related protection.

This Part 1 allows, in conjunction with IEC 62497-2, to take into account advantages resulting from the presence of overvoltage protection when dimensioning clearances.

RAILWAY APPLICATIONS – INSULATION COORDINATION –

Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment

1 Scope

This part of IEC 62497 deals with insulation coordination in railways. It applies to equipment for use in signalling, rolling stock and fixed installations ~~up to 2 000 m above sea level~~.

Insulation coordination is concerned with the selection, dimensioning and correlation of insulation both within and between items of equipment. In dimensioning insulation, electrical stresses and environmental conditions are taken into account. For the same conditions and stresses these dimensions are the same.

An objective of insulation coordination is to avoid unnecessary overdimensioning of insulation.

This standard specifies:

– requirements for clearances and creepage distances for equipment;
– general requirements for tests pertaining to insulation coordination.

The term equipment relates to a section as defined in 3.3; it may apply to a system, a sub-system, an apparatus, a part of an apparatus, or a physical realisation of an equipotential line.

This standard does not deal with :

– distances through solid or liquid insulation;
– distances through gases other than air;
– distances through air not at atmospheric pressure;
– equipment used under extreme conditions.

Product standards have to align with this generic standard.

However, they may require, with justification, different requirements due to safety and/or reliability reasons, e.g. for signalling, and/or particular operating conditions of the equipment itself, e. g. overhead lines which have to comply to established standards or regulations such as EN 50119.

This standard also gives provisions for dielectric tests (type tests or routine tests) on equipment (see Annex B).

NOTE For safety critical systems, specific requirements are needed. These requirements are given in the product specific signalling standard IEC 62425.

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

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

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

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

IEC 60587, *Electrical insulating materials used under severe ambient conditions – Test methods for evaluating resistance to tracking and erosion*

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

IEC 60850, *Railway applications – Supply voltages of traction systems*

IEC 61245, *Artificial pollution tests on high-voltage insulators to be used on d.c. systems*

IEC 61992-1:2006, *Railway applications – Fixed installations – DC switchgear – Part 1: General*

IEC 62236 (all parts), *Railway applications – Electromagnetic compatibility*

EN 50119, *Railway applications – Fixed installations – Electric traction overhead contact lines*

3 Terms and definitions

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

NOTE For the purpose of this standard the following definitions apply according to the following priority order:

– the definition given here-under;
– the definition given in IEC 60664-1;
– the definition given in the documents mentioned in Clause 2 other than IEC 60664-1.

3.1
clearance
the shortest distance in air between two conductive parts

3.2
creepage distance
the shortest distance along the surface of the insulating material between two conductive parts

3.3
sections

3.3.1
section
part of an electrical circuit having its own voltage ratings for insulation coordination

Sections fall into two categories:

3.3.2
earthed section
a section connected to earth or to the car body through a circuit for which interruption is not expected

3.3.3
floating section
a section isolated from earth or from the car body

NOTE 1 A section may be under electrical influence of adjacent sections.

NOTE 2 A particular point of a circuit may be considered as a section.

3.4
voltages

3.4.1
nominal voltage (U_n)
a suitable approximate voltage value used to designate or identify a given supply system

3.4.2
working voltage
the highest r.m.s value of the a.c or d.c voltage which can occur between two points across any insulation, each circuit likely to influence the said r.m.s. value being supplied at its maximum permanent voltage

NOTE Permanent means that the voltage lasts more than 5 min, as U_{max1} in IEC 60850.

3.4.3
rated voltage
the value of voltage assigned by the manufacturer to a component, device or equipment and to which operation and performance characteristics are referred

NOTE Equipment may have more than one rated voltage value or may have a rated voltage range.

3.4.4
rated insulation voltage (U_{Nm})
an r.m.s. withstand voltage value assigned by the manufacturer to the equipment or a part of it, characterising the specified permanent (over 5 min) withstand capability of its insulation

NOTE 1 U_{Nm} is a voltage between a live part of equipment and earth or another live part. For rolling stock, earth refers to the car body.

NOTE 2 For circuits, systems and sub-systems in railway applications this definition is preferred to "highest voltage for equipment" which is widely used in international standards.

NOTE 3 U_{Nm} is higher than or equal to the working voltage. As a consequence, for circuits directly connected to the contact line, U_{Nm} is equal to or higher than U_{max1} as specified in IEC 60850.

NOTE 4 U_{Nm} is not necessarily equal to the rated voltage which is primarily related to functional performance.

3.4.5
working peak voltage
the highest value of voltage which can occur in service across any particular insulation

3.4.6
recurring peak voltage
the maximum peak value of periodic excursions of the voltage waveform resulting from distortions of an a.c. voltage or from a.c. components superimposed on a d.c. voltage

NOTE Random overvoltages, for example due to occasional switching, are not considered to be recurring peak voltages.

3.4.7
rated impulse voltage (U_{Ni})
an impulse voltage value assigned by the manufacturer to the equipment or a part of it, characterising the specified withstand capability of its insulation against transient overvoltages

NOTE U_{Ni} is higher than or equal to the working peak voltage.

3.5
overvoltages
any voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

3.5.1
temporary overvoltage
an overvoltage of relatively long duration due to voltage variations

NOTE A temporary overvoltage is independent of the network load. It is characterised by a voltage/time curve.

3.5.2
transient overvoltage
a short duration overvoltage of a few milliseconds or less due to current transfers

NOTE A transient overvoltage depends on the network load. It cannot be characterised by a voltage/time curve. Basically, a transient overvoltage is the result of a current transfer from a source to the load (network).

Two particular transient overvoltages are defined:

3.5.3
switching overvoltage
the transient overvoltage at any point of the system due to specific switching operation or fault

3.5.4
lightning overvoltage
the transient overvoltage at any point of the system due to a specific lightning discharge.

NOTE The definitions of 3.5 are similar to those of IEC 60664-1 and IEC 60850.

However, the prevalence of the nature of the cause (voltage variations or current transfer) upon time, for segregating transient overvoltages from temporary ones, is clearly stated here (whereas the nature of the cause is not considered in IEC 60664-1).

Long-term (typically 20 ms to typically 1 s) overvoltages defined in IEC 60850, dedicated to contact line networks, are equivalent to temporary overvoltages.

3.6
insulations

3.6.1
functional insulation
the insulation between conductive parts which is necessary only for the proper functioning

3.6.2
basic insulation
the insulation applied to live parts to provide basic protection against electric shock

3.6.3
supplementary insulation
an independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of failure of basic insulation

3.6.4
double insulation
an insulation comprising both basic insulation and supplementary insulation

3.6.5
reinforced insulation
a single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation

NOTE The term "a single insulation system" does not imply that the insulation involves one homogeneous piece. It may involve several layers which cannot be tested singly as basic and supplementary insulation.

4 Basis for insulation coordination

4.1 Basic principles

4.1.1 General

Insulation coordination implies the selection of the electric insulation characteristic of the equipment with regard to its application and in relation to its surroundings.

Insulation coordination can only be achieved if the design of the equipment is based on the stresses to which it is likely to be subjected during its anticipated lifetime.

4.1.2 Insulation coordination with regard to voltage

4.1.2.1 General

Consideration shall be given to:

– the voltages which can appear in the system;
– the voltages generated by the equipment (which could adversely affect other equipment in the system);
– the degree of the expected availability of the equipment;
– the safety of persons and property, so that the probability of undesired incidents due to voltage stresses do not lead to an unacceptable risk of harm;
– the safety of functions for control and protection systems;
– voltages induced in track-side cables;
– the shape of insulating surfaces;
– the orientation and the location of creepage distances;
– if necessary: the altitude that applies.

4.1.2.2 Insulation coordination with regard to permanent a.c. or d.c. voltages

Insulation coordination with regard to permanent voltages is based on:

– rated voltage;
– rated insulation voltage;
– working voltage.

Unless otherwise specified in product standards, permanent voltages last more than five minutes.

4.1.2.3 Insulation coordination with regard to transient overvoltage

Insulation coordination with regard to transient overvoltage is based on controlled overvoltage conditions. There are two kinds of control:

– inherent control: the condition within an electrical system wherein the characteristics of the system can be expected to limit the prospective transient overvoltages to a defined level;
– protective control: the condition within an electrical system wherein specific overvoltage attenuating means can be expected to limit the prospective transient overvoltages to a defined level.