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Railway applications - Insulation coordination - Part 2: Overvoltages and related protection

Bahnanwendungen - Isolationskoordination - Teil 2: Überspannungen und geeignete Schutzmaßnahmen

Applications ferroviaires - Coordination de l'isolement - Partie 2: Surtensions et protections associées

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Applications ferroviaires - Coordination de l'isolement - Partie 2: Surtensions et protections associées

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CENELEC

European Committee for Electrotechnical Standardization
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European foreword

This document (EN 50124-2:2017) has been prepared by CLC/TC 9X, "Electrical and electronic applications for railways."

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2018–02–06
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For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Introduction

This European Standard is part of the EN 50124 series, Railway applications – Insulation coordination.

EN 50124 consists of two parts:

— EN 50124-1, *Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment*;

— EN 50124-2, *Railway applications - Insulation coordination - Part 2: Overvoltages and related protection*.

This Part 2 deals with the shortest durations of overvoltages referred to as Zone A and Zone B in Figure A.1 in Annex A.

1 Scope

This European Standard applies to:

— fixed installations (downstream of the secondary of the substation transformer) and rolling stock equipment linked to the contact line of one of the systems defined in EN 50163;

— rolling stock equipment linked to a train line.

This European Standard gives simulation and/or test requirements for protection against transient overvoltages of such equipment.

Long-term overvoltages are not addressed in this document.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50163:2004, *Railway applications - Supply voltages of traction systems*

EN 50533, *Railway applications - Three-phase train line voltage characteristics*

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

3 Terms and Definitions

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

NOTE The definitions are in accordance with those of EN 50163 (see also Annex A). Long-term, medium-term and short-term overvoltages are equivalent to respectively temporary, switching and lightning overvoltages defined in EN 60664–1.

3.1 Voltages

3.1.1
overvoltage
voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

[SOURCE: EN 60664-1]

3.1.2
long-term overvoltage
overvoltage at relatively long duration due to voltage variations

Note 1 to entry: A long-term overvoltage is independent of the network load. It is characterized by a voltage/time curve.

3.1.3
transient overvoltage
short duration overvoltage of a few milliseconds or less due to current transfer

Note 1 to entry: A transient overvoltage depends on the network load. It cannot be characterized by a voltage/time curve. Basically, a transient overvoltage is the result of a current transfer from a source to the load (network).

3.1.4
medium-term overvoltage
transient overvoltage at any point of the system due to specific switching operation or fault

3.1.5
short-term overvoltage
transient overvoltage at any point of the system due to a specific lightning discharge

3.2
network
set of conductors fulfilling a certain function, the overvoltages of which are likely to damage the equipment they are connected to

4 Contact line network

NOTE The provisions of this Clause 4 do not take into account rapid transient overvoltages in the multimegahertz range such as generated by operation of vacuum circuit breakers which may require a specific overvoltage protection.

4.1 Equipment not protected by a metal-oxide arrester

If the equipment is not protected by a metal-oxide arrester, the protection against overvoltages shall take into account overvoltages limited only by the intrinsic insulation of the contact line and the possible presence of other types of arrester or spark gaps.

4.2 Equipment protected by a metal-oxide arrester

4.2.1 General

If the supplier wants to benefit from the presence of a metal-oxide arrester for reducing constraints resulting from 4.1, the supplier shall perform a simulation of the behaviour of the equipment with its protection against overvoltages according to 4.2.2 and 4.2.3.

Long pulse overvoltages set out in 4.2.2 refers to Zone B in Figure A.1 for switching overvoltages and short pulse overvoltages set out in 4.2.3 refers to Zone A in Figure A.1 for lightning overvoltages.

The circuits of the protected equipment likely to modify the electrical behaviour of the protection shall also be simulated.

The equipment connected to the contact line shall be able to withstand the overvoltages without damage, with the exception of the protective fuse, if any.

4.2.2 Simulation for long pulse

4.2.2.1 Simulation of switching overvoltage scenarios

When specified by the purchaser, the supplier shall perform a simulation of the behaviour of its equipment when there is a transient overvoltage due to current transfer between the contact line and the on-board electrical equipment. The purchaser shall provide the necessary information.

EXAMPLE 1 The overvoltage is generated on the contact line in case of emergency disconnection of all traction converters of a train when they were running at full power.

EXAMPLE 2 The overvoltage is generated on the contact line when a short circuit, occurring in one of the on-board equipment input circuit, is cleared by a protection device (e.g. d.c. circuits breaker, fuse).

NOTE The parameters affecting such simulation are for example: line impedance (inductance and resistance per km), train architecture (e.g. number and type of converters, power diagram), converter power, converter input circuit characteristics (e.g. inductance, capacitance), characteristics of the protection device clearing the short-circuit current (e.g. tripping current or pre-arcing current, turned off current, arc voltage). EN 50388:2012, Clause 11 and Annex D provide limits for short circuit levels and typical values for the line and source impedances for TSI lines.

When the necessary information cannot be obtained from the purchaser, the supplier shall perform the simulation for the conventional long pulse as described in 4.2.2.2.

4.2.2.2 Conventional long pulse

The conventional long pulse is a voltage pulse of trapezoid shape. The pulse duration is 2 ms, with a rise time t_2 of 1,5 ms, a plateau time t_3 of 0,3 ms and a fall time t_4 of 0,2 ms. The peak value of the resulting overvoltage signal is equal to 70 % of the reference voltage U_p defined in Table 1. The overvoltage is applied to the equipment at the line contact as a null impedance voltage source and without considering the presence of its metal-oxide arrester.

Table 1 — Values of the reference voltage U_p

Nominal voltage according to EN 50163 U_n kV	Reference voltage U_p kV
0,75	4
1,5	6
3	12
15	60
25	100

NOTE The values of U_p take into account the values of U_{res} as given in IEC 60099–1 and EN 60099–4 and/or U_{pl} as given in EN 50526–1. But they relate to a theoretical arrester, for simulation purposes only, and present not any direct link to U_{res} of IEC 60099–1 and EN 60099–4 and/or U_{pl} of EN 50526–1.

Figure 1 shows the conventional long pulse used for d.c. contact lines. The trapezoid shape is superimposed on the nominal d.c. line voltage and the starting time has no relevance.