SLOVENSKI STANDARD
SIST EN 50443:2012

01-februar-2012

Učinki elektromagnetne interference na cevovode, ki jih povzročajo visokonapetostni sistemi izmeničnega toka električne vleke in/ali visokonapetostni izmenični napajalni sistemi

Effects of electromagnetic interference on pipelines caused by high voltage a.c. electric traction systems and/or high voltage a.c. power supply systems

Auswirkungen elektromagnetischer Beeinflussungen von Hochspannungswechselstrombahnen und/oder Hochspannungsanlagen auf Rohrleitungen

Effets des perturbations électromagnétiques sur les canalisations causées par les systèmes de traction électrique ferroviaire en courant alternatif et/ou par les réseaux électriques H.T. en courant alternatif

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23.040.99	Drugi sestavni deli za cevovode	Other pipeline components
29.280	Električna vlečna oprema	Electric traction equipment

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CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

This document (EN 50443:2011) has been prepared by Technical Committee CLC/TC 9XC "Electric supply and earthing systems for public transport equipment and ancillary apparatus (Fixed installations)".

This European Standard gives limits relevant to the electromagnetic interference produced by high voltage a.c. railway and power supply systems on metallic pipelines.
Limits are relevant to the interference which can be tolerated on the metallic pipeline, by the equipment connected to it and by persons working on them or in contact with them.

This European Standard indicates the electromagnetic interference situations to which the limits must be related.

Suggestions concerning the interference situations to be examined are given in Annex A. Suggestions concerning the appropriate calculation methods are given in Annex B. Suggestions concerning the appropriate measurement methods are given in Annex C. Suggestions about the use of mitigation measures are given in Annex D. Suggestions for management of interference are given in Annex E.

The following dates are fixed:

– latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-10-24

– latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2014-10-24

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1 Scope

The presence of a.c. power supply systems or of a.c. electric traction systems (in this standard also indicated as a.c. power systems) may cause voltages to build up in pipeline systems, (in this standard indicated as interfered systems) running in the close vicinity, due to one or more of the following mechanisms:

– inductive coupling,
– conductive coupling,
– capacitive coupling.

Such voltages may cause danger to persons, damage to pipelines or connected equipment or disturbance to the electrical/ electronic equipment connected to the pipeline.

This European Standard deals with the situations where these effects may arise and with the maximum tolerable limits of the interference effects, taking into account the behaviour of the a.c power systems both in normal operating condition and/or during faults.

NOTE In the worst case, the pipe may not disperse current to ground. As a consequence, the prospective touch voltage coincides with the interference voltage.

This European Standard applies to all metallic pipelines irrespective of the conveyed fluid, e.g. liquid or gas, liable to be interfered by high voltage a.c. railway and high voltage a.c. power supply systems.

The objective of this standard is to establish:
– the procedure for evaluating the electromagnetic interference;
– the interference distance to be considered;
– the types of coupling to be considered for operating and fault conditions of the high voltage a.c. electric traction systems and high voltage a.c. power supply systems;
– the configurations to be considered for both metallic pipeline and high voltage a.c. electric traction systems or high voltage a.c. power systems;
– the limits of the voltages due to the electromagnetic interference;
– information on interference situations, calculation methods, measuring methods, mitigation measures, management of interference.

This European Standard is applicable to all new metallic pipelines and all new high voltage a.c. electric traction systems and high voltage a.c. power supply systems and all major modifications that may change significantly the interference effect.

This European Standard only relates to phenomena at the fundamental power frequency (e.g. 50 Hz or 16,7 Hz).

This European Standard does not apply to:

– all aspects of corrosion,
– the coupling from a.c. railway and power supply systems with nominal voltages less than or equal to 1 kV,
– interference effects on the equipment not electrically connected to the pipeline.

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 60050-161, *International Electrotechnical Vocabulary — Chapter 161: Electromagnetic compatibility*

IEC 60050-195, *International Electrotechnical Vocabulary — Part 195: Earthing and protection against electric shock*

IEC 60050-826, *International Electrotechnical Vocabulary — Part 826: Electrical installations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the International Electrotechnical Vocabulary (IEV) apply, unless they are defined in this European Standard:

3.1
a.c. electric traction system
a.c. railway electrical distribution network used to provide energy for rolling stock

NOTE The system may comprise:

- contact line systems,
- return circuit of electric railway systems,
- running rails of non-electric railway systems, which are in the vicinity of, and conductively connected to the running rails of an electric railway system.

3.2
a.c power supply system
a.c. electrical system devoted to electrical energy transmission and including overhead lines, cables, substations and all apparatus associated with them

NOTE This includes HV transmission lines with 16,7 Hz.

3.3
a.c. power system
a.c. electric traction system or a.c. power supply system

NOTE Where it is necessary to differentiate, each interfering system is clearly indicated with its proper term.

3.4
interfering system
general expression encompassing an interfering high voltage a.c. electric traction system and/or high voltage a.c. power supply system

3.5
interfered system
system on which the interference effects appear

NOTE In this standard pipeline system.

3.6
pipeline system
system of pipe network with all associated equipment and stations

NOTE 1 In this standard pipeline system refers only to metallic pipeline system.

NOTE 2 The associated equipment is the equipment electrically connected to the pipeline.

3.7
earth
conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero

[IEC 60050-826-04-01]

3.8
operating condition
fault free operation of any system

NOTE Transients are not to be considered as an operating condition.

3.9
fault condition
non intended condition caused by short-circuit to earth, the fault duration being the normal clearing time of the protection devices and switches

NOTE The short circuit is an unintentional connection of an energized conductor to earth or to any metallic part in contact with earth.

3.10
conductive coupling
coupling which occurs when a part of the current belonging to the interfering system returns to the system earth via the interfered system or when the voltage to the reference earth of the ground in the vicinity of the influenced object rises because of a fault in the interfering system, and the results of which are conductive voltages and currents

3.11
inductive coupling
phenomenon whereby the magnetic field produced by a current carrying circuit influences another circuit; the coupling being quantified by the mutual impedance of the two circuits, and the results of which are induced voltages and hence currents that depend for example on the distances, length, inducing current, circuit arrangement and frequency

3.12
capacitive coupling
phenomenon whereby the electric field produced by an energized conductor influences another conductor, the coupling being quantified by the capacitance between the conductors and the capacitances between each conductor and earth, and the results of which are interference voltages into conductive parts or conductors insulated from earth, these voltages depending for example on the voltage of the influencing system, distances and circuit arrangement

3.13
interference
phenomenon resulting from conductive, capacitive, inductive coupling between systems, and which can cause malfunction, disturbance, danger, damage, etc.

3.14
disturbance
malfunction of an equipment loosing its capability of working properly for the duration of the interference

NOTE When the interference disappears, the interfered system starts again working properly without any external intervention.

3.15
damage
permanent reduction in the quality of service which can be offered by the interfered system

NOTE 1 Examples of damages are: coating perforation, pipe pitting, pipe perforation, permanent malfunction of the equipment connected to the pipes, etc.

NOTE 2 A reduction in the quality of service may be also the complete cancellation of service.

3.16
interference situation
situation in which an interference may appear (permanently or intermittently) between an a.c. power system and a metallic pipeline system, a given interference situation being defined by the geometrical and electrical data of the a.c. power system and of the metallic pipeline system as well as defined by the data describing the medium between the two systems

NOTE An interference situation may cause:

- danger to persons;
- damage to the pipeline and/or to the connected equipment;
- disturbance of the electrical and/or electronic equipment connected to the pipeline.

3.17
interference distance
maximum distance between the pipeline system and a.c. power system for which an interference shall be considered

3.18
interfering current
vectorial sum of the currents flowing through the conductors relevant to the a.c. power system (i.e. catenaries, feeders, return conductors, phase conductors, earth wires)

NOTE This interfering current is used to simplify the calculations when the distances between the interfering system and the interfered system is high as compared to the distances between the conductors of the interfering system.

3.19
interference voltage
voltage caused on the interfered system by the conductive, inductive and capacitive coupling with the nearby interfering system between a given point and the earth or across an insulating joint

3.20
prospective touch voltage
voltage between simultaneously accessible conductive parts when those conductive parts are not being touched by a person or an animal

NOTE In the case dealt in this standard the prospective touch voltage coincides with the interference voltage. This is due to the fact that in the worst case the interfered pipe may not disperse current to ground.

[IEC 60050-195-05-09]

3.21
skilled person
person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create

[IEC 60050-195-04-01]

3.22
(electrically) instructed person
person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid hazards which electricity can create

[IEC 60050-195-04-02]

3.23
immunity
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[IEC 60050-161]

3.24
environmental reduction factor
factor which represents the reduction of interference voltage associated with the presence of extended earthed extraneous metallic structures

NOTE The value of the environmental reduction factor depends on many parameters (e.g. impedance of the circuit made of the structure and the earth).

3.25
reduction factor
factor which represents the reduction of interference voltage associated with the presence of the current flowing through the tracks, the return conductors, the cable shields, the shield wires, etc.

3.26
rural area
area which has a low density of local metallic structures in direct electrical contact with the soil

3.27
urban area
area which contains a high density of local metallic structures in direct electrical contact with the soil such as water pipes, cables with bare metal sheaths, railway tracks, earthing structures of buildings, masts and foundations

4 Procedure

In order to evaluate the acceptability of an interference produced by an a.c. power system on a metallic pipeline system, the following design steps apply:

a) define the interference distance to be considered, according to Clause 5;
b) define the interference situations to be examined (worst cases of interference), according to Clause 6;
c) select the involved coupling type(s) to be considered, according to Clause 7;
d) select the involved interference effect(s) to be considered, according to Clause 8;
e) assess the interference result(s) for each effect selected in the previous step, according to Clause 9;
f) select the acceptable limit for each of the results assessed in the previous step, according to Clause 10;
g) determine the interference results on the metallic pipeline system by calculation or measurement, according to Clause 11;
h) compare the interference results with the relevant limits; if the comparison shows that the interference situation is unacceptable, mitigation measures shall be applied, according to Clause 12.

The procedure shall be carried out twice, i.e. considering short term interference (due to a.c. power system in fault conditions) and long term interference (due to a.c. power system in operating conditions).

The design steps shall be supported and agreed by the involved parties.

5 Interference distance

5.1 General

The a.c. power systems located at a distance less than or equal to the interference distance from a given metallic pipeline system shall be considered as interfering systems for this pipeline system.

The objective of interference distance is to limit the number of interfering systems to be considered and for which assessing the interfering currents/voltages is necessary.