

**RAUDTEEALASTE RAKENDUSTE PÜSIPAIGALDISED.
ELEKTRIOHUTUS, MAANDAMINE JA TAGASIVOOLOUAHEL.
OSA 3: ALALIS- JA VAHELDUVVOOLU VEOSÜSTEEMIDE
VASTASTIKUSED KOOSTOIMED**

Fixed installations for railway applications - Electrical safety, earthing and the return circuit - Part 3: Mutual Interaction of AC and DC traction systems

EESTI STANDARDI EESSÕNA**NATIONAL FOREWORD**

See Eesti standard EVS-EN 50122-3:2022+A1:2025 sisaldab Euroopa standardi EN 50122-3:2022 ja selle muudatuse A1:2025 ingliskeelset teksti.	This Estonian standard EVS-EN 50122-3:2022+A1:2025 consists of the English text of the European standard EN 50122-3:2022 and its amendment A1:2025
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas. Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 02.09.2022, muudatus A1 01.08.2025.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation. Date of Availability of the European standard is 02.09.2022, for A1 01.08.2025.
Muudatusega A1 lisatud või muudetud teksti algus ja lõpp on tekstis tähistatud sümboolitega A1 A1 .	The start and finish of text introduced or altered by amendment A1 is indicated in the text by tags A1 A1 .
Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 29.120.50; 29.280

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autoriõiguse kaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about standards copyright protection, please contact the Estonian Centre for Standardisation and Accreditation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

A1 Fixed installations for railway applications **A1** - Electrical safety, earthing and the return circuit - Part 3: Mutual Interaction of AC and DC traction systems

A1 Installations fixes pour applications ferroviaires **A1** - Sécurité électrique, mise à la terre et circuit de retour - Partie 3: Interactions mutuelles entre systèmes de traction en courant alternatif et en courant continu

A1 Ortsfeste Anlagen für Bahnanwendungen **A1** - Elektrische Sicherheit, Erdung und Rückleitung - Teil 3: Gegenseitige Beeinflussung von Wechselstrom- und Gleichstrombahnen

This European Standard was approved by CENELEC on 2022-07-25. Amendment A1 was approved by CENELEC on 2025-06-23. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard and its amendment the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard and its Amendment A1 exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	4
[A1] Amendment A1 European foreword [A1]	5
1 Scope	6
2 Normative references	7
3 Terms and definitions	7
4 Hazards and adverse effects	7
4.1 General	7
4.2 Electrical safety of persons	7
5 Types of mutual interaction to be considered	7
5.1 General	7
5.2 Galvanic coupling	8
5.2.1 AC and DC return circuits not directly connected	8
5.2.2 AC and DC return circuits directly connected or common	8
5.3 Non-galvanic coupling	8
5.3.1 Inductive coupling	8
5.3.2 Capacitive coupling	9
6 Zone of mutual interaction	9
6.1 General	9
6.2 Effects of AC railway systems on DC railway systems	9
6.3 Effects of DC railway systems on AC railway systems	10
7 Touch voltage limits for the combination of alternating and direct voltages	10
7.1 General	10
7.2 Touch voltage limits for long-term conditions	11
7.3 AC system short-term conditions and DC system long-term conditions	11
7.4 AC system long-term conditions and DC system short-term conditions	12
7.5 AC system short-term conditions and DC system short-term conditions	13
7.6 Workshops and similar locations	13
8 Technical requirements and measures inside the zone of mutual interaction	14
8.1 General	14
8.2 Requirements if the AC railway and the DC railway have separate return circuits	14
8.2.1 General	14
8.2.2 Return circuit or parts connected to the return circuit of one system located in the OCLZ and/or CCZ of the other system	14
8.2.3 Common buildings and common structures	15
8.2.4 Inductive and capacitive coupling	16
8.3 Requirements if the AC railway and the DC railway have common return circuits and use the same tracks	16
8.3.1 General	16
8.3.2 Measures against stray current	16
8.3.3 Common structures and common buildings	17
8.3.4 Exceptions	17
8.3.5 Design of overhead contact line	17
8.3.6 Inductive and capacitive coupling	17
8.4 System separation sections and system separation stations	17
Annex A (informative) Zone of mutual interaction	18
A.1 General	18
A.2 AC system as source	18

A.2.1	Main parameters	18
A.2.2	Basic analysis.....	18
A.2.3	Parameter variations	21
A.3	DC system as source	23
Annex B (informative)	Analysis of combined voltages	24
Annex C (informative)	Analysis and assessment of mutual interaction	29
C.1	General.....	29
C.2	Analysis of mutual interaction.....	29
C.3	System configurations to be taken into consideration.....	29

Figures

Figure 1	— Maximum permissible combined effective touch voltages (excluding workshops and similar locations) for long-term conditions	11
Figure 2	— Maximum permissible combined effective touch voltages under AC short-term conditions and DC long-term conditions	12
Figure 3	— Maximum permissible combined effective touch voltages under AC long-term conditions and DC short-term conditions	13
Figure 4	— Maximum permissible combined effective touch voltages in workshops and similar locations excluding short-term conditions	14
Figure 5	— Example of where a VLD shall be suitable for both alternating and direct voltage	15
Figure A.1	— Overview of voltages coupled in as function of distance and soil resistivity I.....	19
Figure A.2	— Overview of voltages coupled in as function of distance and soil resistivity II.....	20
Figure A.3	— Relation between length of parallelism and zone of mutual interaction caused by an AC railway	21
Figure B.1	— Definition of combined peak voltage	25
Figure B.2	— Overview of permissible combined AC and DC voltages.....	26
Figure B.3	— Overview of permissible voltages in case of a duration $\geq 1,0$ s both AC voltage and DC voltage.....	27
Figure B.4	— Permissible voltages in case of a duration 0,1 s AC voltage and a duration 300 s DC voltage.....	28

European foreword

This document (EN 50122-3:2022) has been prepared by CLC/SC 9XC “Electric supply and earthing systems for public transport equipment and ancillary apparatus (Fixed installations)”.

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) 2023-07-25
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2025-07-25

This document supersedes EN 50122-3:2010 and all of its amendments and corrigenda (if any).

EN 50122-3:2022 includes the following significant technical changes with respect to EN 50122-3:2010:

- harmonization with EN 50122-1:2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights

This document has been prepared under a Standardization Request given to CENELEC by the European Commission and the European Free Trade Association.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

A1 Amendment A1 European foreword

This document (EN 50122-3:2022/A1:2025) was prepared by SC 9XC, "Electric supply and earthing systems for public transport equipment and ancillary apparatus (fixed installations)", of 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) 2026-08-31
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2028-08-31

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a Standardization Request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website. **A1**

1 Scope

This document specifies requirements for the protective provisions relating to electrical safety in fixed installations, when it is reasonably likely that hazardous voltages or currents will arise for people or equipment, as a result of the mutual interaction of AC and DC electric power supply traction systems.

It also applies to all aspects of fixed installations that are necessary to ensure electrical safety during maintenance work within electric power supply traction systems.

The mutual interaction can be of any of the following kinds:

- parallel running of AC and DC electric traction power supply systems;
- crossing of AC and DC electric traction power supply systems;
- shared use of tracks, buildings or other structures;
- system separation sections between AC and DC electric traction power supply systems.

The scope is limited to galvanic, inductive and capacitive coupling of the fundamental frequency voltages and currents and their superposition.

This document applies to all new lines, extensions and to all major revisions to existing lines for the following electric traction power supply systems:

- a) railways;
- b) guided mass transport systems such as:
 - 1) tramways,
 - 2) elevated and underground railways,
 - 3) mountain railways,
 - 4) magnetically levitated systems, which use a contact line system,
 - 5) trolleybus systems, and
 - 6) electric traction power supply systems for road vehicles, which use an overhead contact line system;
- c) material transportation systems.

The document does not apply to:

- a) electric traction power supply systems in underground mines;
- b) cranes, transportable platforms and similar transportation equipment on rails, temporary structures (e.g. exhibition structures) in so far as these are not supplied directly or via transformers from the contact line system and are not endangered by the electric traction power supply system for railways;
- c) suspended cable cars;
- d) funicular railways;
- e) procedures or rules for maintenance.

The rules given in this document can also be applied to mutual interaction with non-electrified tracks, if hazardous voltages or currents can arise from AC or DC electric traction power supply systems.

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.

EN 50122-1:2022, *Railway applications – Fixed installations – Electrical safety, earthing and the return circuit – Part 1: Protective provisions against electric shock*

EN 50122-2:2022, *Railway applications – Fixed installations – Electrical safety, earthing and the return circuit – Part 2: Provisions against the effects of stray currents caused by DC traction systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50122-1:2022 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Hazards and adverse effects

4.1 General

The different requirements specified in EN 50122-1:2022 and EN 50122-2:2022, concerning connections to the return circuit of the AC railway, and connections to the return circuit of the DC railway, shall be taken into account in order to avoid risks of hazardous voltages and stray currents.

Such hazards and risks shall be considered from the start of the planning of any installation which includes both AC and DC railways. Suitable measures shall be specified for limiting the voltages to the levels given in this document, while limiting the damaging effects of stray currents in accordance with EN 50122-2:2022.

Additional adverse effects are possible, for example:

- thermal overload of conductors, screens and sheaths;
- thermal overload of transformers due to magnetic saturation of the cores;
- restriction of operation because of possible effects on the safety and correct functioning of signalling systems;
- restriction of operation because of malfunction of the communication system.

These effects are not considered in this Standard.

4.2 Electrical safety of persons

Where AC and DC voltages are present together the limits for touch voltage given in Clause 7 apply in addition to the limits given in EN 50122-1:2022, Clause 9.

5 Types of mutual interaction to be considered

5.1 General

Coupling describes the physical process of transmission of energy from a source to a susceptible device.

The following types of coupling shall be considered:

- a) galvanic (conductive) coupling;
- b) non-galvanic coupling,