



BSI Standards Publication

Fixed installations for railway applications — Electrical safety, earthing and the return circuit

Part 1: Protective provisions against electric shock

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

National foreword

This British Standard is the UK implementation of EN 50122-1:2022+A1:2025. It supersedes BS EN 50122-1:2022, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee GEL/9/3, Railway Electrotechnical Applications - Fixed Equipment.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2025
Published by BSI Standards Limited 2025

ISBN 978 0 539 31589 9

ICS 29.120.50; 29.280

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2022.

Amendments/corrigenda issued since publication

Date	Text affected
31 August 2025	Implementation of CEN amendment A1:2025

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

EUROPÄISCHE NORM

August 2025

ICS 29.280

Supersedes EN 50122-1:2011; EN 50122-1:2011/A1:2011; EN 50122-1:2011/AC:2012; EN 50122-1:2011/A2:2016; EN 50122-1:2011/A3:2016; EN 50122-1:2011/A4:2017

English Version

A1 Fixed installations for railway application - Electrical safety, earthing and the return circuit - Part 1: Protective provisions against electric shock **A1**

Applications ferroviaires - Installations fixes - Sécurité électrique, mise à la terre et circuit de retour - Partie 1: Mesures de protection contre les chocs électriques

Bahnanwendungen - Ortsfeste Anlagen - Elektrische Sicherheit, Erdung und Rückleitung - Teil 1: Schutzmaßnahmen gegen elektrischen Schlag

This European Standard was approved by CENELEC on 2022-07-25. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard 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 exists 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

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

Contents		Page
European foreword		7
1	Scope.....	8
2	Normative references	9
3	Terms and definitions	10
3.1	Electrical safety and hazards.....	10
3.2	Earthing and equipotential bonding.....	12
3.3	Return circuit.....	14
3.4	Electric traction power supply system	16
3.5	Contact line.....	17
3.6	Corrosion and corrosion protection	20
3.7	Current collection.....	20
3.8	Residual current devices	21
3.9	General terms.....	21
4	Contact line zone and current collector zone	24
4.1	Overhead contact line.....	24
4.2	Ground level conductor rail.....	27
4.3	Trolleybuses and road vehicles using an overhead contact line.....	27
4.4	Limitation of the zones.....	28
5	Protective provisions against direct contact	29
5.1	Preconditions	29
5.1.1	General.....	29
5.1.2	Design procedure	29
5.1.3	Electrical clearances.....	30
5.1.4	Standing surface.....	31
5.2	Protection by clearance	32
5.2.1	Calculation method for protection by clearance	32
5.2.2	Dimensions of clearances	33
5.2.3	Clearances for working persons.....	35
5.2.4	Warning signs.....	35
5.2.5	Minimum height of wires of an overhead contact line system above traffic areas	36
5.2.6	Clearances above standing surfaces on vehicles	36
5.2.7	Feeders above loading roads.....	36
5.2.8	Clearance between live parts of overhead contact line systems and trees and bushes	36
5.3	Protection by electrically protective obstacles.....	36
5.3.1	General.....	36
5.3.2	Common requirements for electrically protective obstacles.....	37
5.3.3	Methods for determining reach.....	38
5.3.4	Requirements for electrically protective obstacles.....	40
5.3.5	Specific requirements for electrically protective obstacles in restricted areas	46
5.3.6	Anti climbing provisions.....	47
5.4	Protection against direct contact with live parts mounted on vehicles	47
5.5	Protective provisions allowing working under live conditions.....	48
5.5.1	General.....	48
5.5.2	Overhead contact lines for railways beneath structures	49
5.5.3	Overhead contact lines for trolley busses and electric road vehicles beneath structures	49

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

5.6	Specific protective provisions against electric shock in ground level conductor rail systems	51
5.6.1	Location of conductor rail at platforms	51
5.6.2	Exceptions	51
5.6.3	Protection provisions in workshops and depots	51
5.6.4	Protective boarding for ground level conductor rails in restricted areas	52
5.6.5	Requirements for top contact ground level conductor rails in public areas	52
5.6.6	Requirements for top contact ground level conductor rails in restricted areas	52
5.7	Specific protective provisions against electric shock in systems in which the wheels of the vehicles are not used for return circuit	55
5.7.1	General	55
5.7.2	Railway systems	55
5.7.3	Trolleybus systems and systems for electric road vehicles	55
6	Protective provisions against indirect contact and non-galvanic coupling	56
6.1	General	56
6.2	Protective provisions for exposed-conductive-parts	56
6.2.1	AC railways	56
6.2.2	DC railways	57
6.2.3	Exceptions for low voltage electric traction power supply systems	57
6.2.4	Stays of non-conductive masts	58
6.3	Protective provisions for wholly or partly conductive structures in the overhead contact line zone or the current collector zone	58
6.3.1	Protective provisions by means of connection to the return circuit	58
6.3.2	Exceptions for small wholly and partly conductive parts	59
6.3.3	Exceptions for temporarily stored parts close to the rails	59
6.3.4	Protective provisions preventing contact between conductive parts and live parts	59
6.3.5	Protective provisions by means of bare conductive parts connected to the return circuit	60
6.3.6	Protective provisions by automatic disconnection of supply	60
6.4	Parts which can become hazardous due to inductive or capacitive coupling	60
7	Protective provisions for low voltage non-traction power supply systems	60
7.1	General	60
7.2	Protective provisions for electrical installations in the overhead contact line zone or the current collector zone	61
7.2.1	Equipment of protection Class I	61
7.2.2	Equipment of protection Class II	63
7.2.3	Cables	63
7.2.4	Low voltage connected equipment	63
7.3	Protective provisions for installations which are endangered by the traction power supply return circuit	63
7.3.1	Design of low voltage non-traction power supply	63
7.3.2	Low voltage power supply by a TT system on the railway side	64
7.3.3	Low voltage power supply by TN system	67
7.3.4	Low voltage power supply by IT system	69
7.3.5	Special provisions	71
8	Protective provisions where track systems, which are utilized for carrying traction return current, or/and overhead contact line systems pass through hazardous zones	74
8.1	General	74
8.2	Equipotential bonding	75
8.3	Parallel pipework	76

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

8.4	Insulating joints	76
8.5	Surge arrester.....	76
8.6	Overhead contact line of loading sidings.....	77
9	Limits for touch voltage and protective provisions against the danger of rail potential.....	77
9.1	General.....	77
9.1.1	Preconditions.....	77
9.1.2	Body voltage and touch voltage.....	77
9.1.3	Touch voltage at vehicles.....	77
9.1.4	Short-circuit duration.....	78
9.1.5	Voltage limits and time duration aspects.....	78
9.2	Touch voltage limits in AC railways.....	78
9.2.1	General.....	78
9.2.2	AC voltage limits for the safety of persons.....	79
9.3	Touch voltage limits in DC railways.....	82
9.3.1	General.....	82
9.3.2	DC voltage limits for the safety of persons.....	82
9.4	Access Control.....	85
10	Additional requirements.....	85
10.1	Traction substations and traction switching stations.....	85
10.2	Cables.....	85
10.2.1	General requirements.....	85
10.2.2	Cables in AC electric traction power supply systems.....	86
10.2.3	Cables in DC electric traction systems.....	86
10.3	Extended return circuit connections and earthing conductors.....	86
10.3.1	General requirements.....	86
10.3.2	Continuity of the extended return circuit.....	86
10.3.3	Cross bonding of the return circuit.....	87
10.3.4	Railway systems in which the traction current is confined within insulated conductors.....	87
10.4	Removing of decommissioned contact lines.....	87
10.5	Means of achieving safe isolation between sections.....	87
10.6	Lightning protection.....	87
Annex A (normative)	Clearances from standing surfaces for exceptional use on existing lines with restricted gauge.....	88
Annex B (informative)	Typical layouts of protective obstacles.....	90
B.1	General.....	90
B.2	Examples.....	92
Annex C (normative)	Warning sign.....	99
Annex D (informative)	Guiding values for rail potential gradient.....	100
D.1	AC railways.....	100
D.2	DC railways.....	101
Annex E (informative)	Effective touch voltage and body voltage with respect to the body current.....	102
E.1	Preconditions for the calculation.....	102
E.2	Impedances.....	102
E.3	Body current and related body voltage.....	105
Annex F (normative)	Measurement methods for effective touch voltages.....	108
Annex G (normative)	Use of voltage-limiting devices.....	109
G.1	General.....	109

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

G.2	Types	109
G.3	Technical requirements	109
	Bibliography	111

Figures

Figure 1	— Overhead contact line zone and current collector zone	26
Figure 2	— Overhead contact line zone and current collector zone for trolley bus systems and electric road vehicles using a bipolar contact line	28
Figure 3	— Design procedure to achieve protection against direct contact	30
Figure 4	— Manikin model to be used for the analysis of the arm's reach	32
Figure 5	— Minimum distances to accessible live parts from standing surfaces accessible to persons	34
Figure 6	— Application of taut string line method compared with manikin method.	39
Figure 7	— Minimum distance behind electrically protective obstacles with openings	42
Figure 8	— Example for a gap between a standing surface and an electrically protective obstacle, side view	44
Figure 9	— Effect of an electrically protective obstacle on arms reach of person including an object, top view	45
Figure 10	— Live parts below standing surfaces	46
Figure 11	— Method for the determination of clearances for live parts on the outside of vehicles	48
Figure 12	— Example of an insulated obstacle beneath a structure	49
Figure 13	— Example of an insulated electrically protective obstacle beneath a structure for an unearthed installation	50
Figure 14	— Example of an insulated electrically protective obstacle beneath a structure for a bipolar overhead contact line in which the negative contact wire is earthed or connected to the return circuit of a tramway system	51
Figure 15	— Public level crossing, private level crossing	52
Figure 16	— Trackside structures	53
Figure 17	— Track-side telephone mounted on a signal-post	53
Figure 18	— Authorized trackside walking route	54
Figure 19	— Railway controlled crossing (depots, goods yard, station crossing)	54
Figure 20	— Protection Class I equipment installed outside the overhead contact line zone and the current collector zone.	62
Figure 21	— Typical TT system for AC railways.	65
Figure 22	— Typical TT system for DC railways.	66
Figure 23	— Typical TN system for AC railways	68
Figure 24	— Typical TN system for DC railways	69
Figure 25	— Typical IT system for AC railways	70
Figure 26	— TN system for AC railways with interconnected earth system.	72
Figure 27	— TN system for AC railways with multiple supply points.	73
Figure 28	— Disposition of rail-to-rail cross bonds and track-to-track cross bonds (double-rail illustration) and connection of the contact line in case of the loading siding having a contact line	76
Figure 29	— Location of a surge arrester outside the overhead contact line zone of a loading siding if there is a possibility of flashovers of the insulating pieces through lightning strikes	76
Figure 30	— Design of return circuit, with regard to permissible effective touch voltage by checking the rail potential or the effective touch voltage	79
Figure A.1	— Alternative clearances for existing lines/networks.	89
Figure B.1	— Typical protective obstacles and obstacle combinations and their dimensions and properties	91

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

Figure B.2 — Inclined protective obstacle, total height 1,00 m, solid-wall	92
Figure B.3 — Solid-wall protective obstacle, total height 1,69 m (balustrade wall).....	93
Figure B.4 — Combined protective obstacle with an inclined part on the top of the main protective obstacle, total height 1,50 m.....	94
Figure B.5 — Combined protective obstacle with an inclined part (0,50 m width) on the standing surface level, total height 1,00 m.....	95
Figure B.6 — Combined protective obstacle with an inclined part (1,60 m width) on the standing surface level, total height 1,00 m.....	96
Figure B.7 — Combined protective obstacle with a total height of 1,80 m.....	97
Figure B.8 — Arrangement of three protective obstacles.....	98
Figure C.1 — Warning sign	99
Figure D.1 — Guidance values for the rail potential gradient measured at the mast in a right angle to the track of an AC railway.....	100
Figure E.1 — Equivalent circuit for the calculation of the permissible touch voltage	104

Tables

Table 1 — Electrical clearances	31
Table 2 — Protection clearances.....	31
Table 3 — Minimum vertical height V of accessible live parts above standing surfaces for public areas.....	35
Table 4 — Minimum distance d_0 between live parts and an electrically protective obstacle	43
Table 5 — Maximum dimensions for small wholly and partly conductive parts	59
Table 6 — Types of low voltage non-traction supplies	64
Table 7 — Maximum permissible body voltages $U_{b, \max}$ in AC electric traction power supply systems as a function of time duration	80
Table 8 — Maximum permissible effective touch voltages $U_{te, \max}$ in AC electric traction power supply systems as a function of time duration.....	81
Table 9 — Maximum permissible body voltages $U_{b, \max}$ in DC electric traction power supply systems as a function of time duration	83
Table 10 — Maximum permissible effective touch voltages $U_{te, \max}$ in DC electric traction power supply systems as a function of time duration.....	83
Table D.1 — Guidance values for the rail potential gradient (see Figure D.1).....	101
Table E.1 — Body impedance Z_b , body resistance R_b and body current I_b	103
Table E.2 — Example of the maximum permissible prospective touch voltage for AC railways for short-term conditions and $R_a = 1\ 150\ \Omega$	105
Table E.3 — Body currents, body voltages and touch voltages as function of time duration in AC electric traction power supply systems.....	106
Table E.4 — Body currents, body voltages and touch voltages as function of time duration in DC electric traction power supply systems.....	107

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

This document (EN 50122-1:2022) 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 50122-1:2011 and all of its amendments and corrigenda (if any).

EN 50122-1:2022 includes the following significant technical changes with respect to EN 50122-1:2011:

- some definitions were modified;
- the dimensions for protection by clearance were modified, and there are now voltage dependent differences for high voltage electric traction power supply systems;
- methods for the use of protective obstacles were significantly changed.

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.

European foreword to Amendment 1

This document (EN 50122-1:2022/A1:2025) has been 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.

This is a preview of BS EN 50122-1:2022+A1:2025. [Click here to purchase the full version from the ANSI store.](#)

1 Scope

This document specifies requirements for the protective provisions relating to electrical safety in fixed installations associated with AC and/or DC traction systems and to any installations that can be endangered by the electric traction power supply system. This also includes requirements applicable to vehicles on electrified lines.

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

This document applies to new electric traction power supply systems and major revisions to electric traction power supply systems for:

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

This 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,
- c) suspended cable cars,
- d) funicular railways,
- e) existing vehicles.

This document does not specify working rules for maintenance.

The requirements within this document related to protection against electric shock are applicable to persons only.