

BS EN 50122-1:2011+A4:2017

Incorporating corrigenda November 2012 and May 2013



BSI Standards Publication

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

Part 1: Protective provisions against
electric shock

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National foreword

This British Standard is the UK implementation of EN 50122-1:2011+A4:2017, incorporating corrigendum November 2012. It supersedes BS EN 50122-1:2011+A3:2016 which is withdrawn.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 CENELEC text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A1 is indicated by A1 A1.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CENELEC corrigendum November 2012 is indicated in the text by AC1 AC1.

In 7.4.1 NOTE 1, reference is made to the TN and TT systems of earth connection for low-voltage distribution systems. Table 2 shows only TT and TN systems, although other systems are allowed by the NOTE 2. For application in the UK, it should be noted that IT systems are not prohibited by this standard.

Attention is drawn to the fact that work is currently in hand to replace the United Kingdom special national condition set out in Annex G (5.2.1). Until this national condition is revised, an appropriate risk assessment is considered essential if public area clearances of less than the minimum set out in Figure 4 (clause 5.2.1) are to be used.

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

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2017

ISBN 978 0 580 97662 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 May 2011.

Amendments/corrigenda issued since publication

Date	Text affected
31 July 2011	Implementation of CENELEC amendment A1:2011
31 November 2012	Implementation of CENELEC corrigendum November 2012
31 May 2013	Additional information included in the national foreword
31 January 2016	Implementation of CENELEC amendment A2:2016
30 November 2016	Implementation of CENELEC amendment A3:2016: Annex ZZ updated
28 February 2017	Implementation of CENELEC amendment A4:2017

English version

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

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

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CENELEC

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

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Foreword

This European Standard was prepared by SC 9XC, Electric supply and earthing systems for public transport equipment and ancillary apparatus (Fixed installations), of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways. It was submitted to the formal vote and was approved by CENELEC as EN 50122-1 on 2010-11-16.

This document supersedes EN 50122-1:1997.

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- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2011-11-16
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2013-11-16

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directives 96/48/EC (HSR), 2001/16/EC (CONRAIL) and 2008/57/EC (RAIL). See Annex ZZ.

Foreword to amendment A1

This amendment to the European Standard EN 50122-1:2011 was prepared by SC 9XC, Electric supply and earthing systems for public transport equipment and ancillary apparatus (Fixed installations), of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as Amendment A1 to EN 50122-1:2011 on 2011-04-25.

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- latest date by which the amendment has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2012-04-25
- latest date by which the national standards conflicting
with the amendment have to be withdrawn (dow) 2014-04-25

Foreword to amendment A2

This document (EN 50122-1:2011/A2:2016) has been prepared by CLC/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) 2016-11-23
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2018-11-23

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For the relationship with EU Directive(s) see informative Annex ZZ, included in EN 50122-1:2011.

Foreword to amendment A3

This document (EN 50122-1:2011/A3:2016) 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) 2016-12-03
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2016-12-03

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For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Foreword to amendment A4

This document (EN 50122-1:2011/A4:2017) 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) 2017-12-14
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2019-12-14

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For the relationship with EU Directive(s) see informative Annex ZZ of EN 50122-1:2011.

Annex ZZ

(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Annex III of the EC Directive 2008/57/EC (also named as New Approach Directive 2008/57/EC Rail Systems: Interoperability).

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZZ.1 for “Energy” confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZZ.1 - Correspondence between this European Standard, the TSI “Energy” (REGULATION (EU) No 1301/2014 of 18 November 2014) and Directive 2008/57/EC

Clauses of this European Standard	Chapter / § / points / of ENE TSI	Essential Requirements (ER) of Directive 2008/57/EC	Comments
The whole standard is applicable.		1. General Requirements 1.1 Safety 1.5 Technical compatibility	
Clauses directly referenced in the TSI:	4.2.7. Electrical protection coordination arrangements	2. Requirements specific to each sub-subsystem 2.2 Energy 2.2.1 Safety 2.2.3. Technical compatibility	References to the standard EN 50122-1 should be updated in the TSI
5.2.4 5.2.5	4.2.9. Geometry of the overhead contact line 4.2.9.1. Contact wire height		
5.2.1 5.3.1 5.3.2 6.1.6.2 9.2.2.1 9.2.2.2 9.3.2.1 9.3.2.2	4.2.18. Protective provisions against electric shock		

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

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1 Scope

This European Standard specifies requirements for the protective provisions relating to electrical safety in fixed installations associated with a.c. and/or d.c. traction systems and to any installations that can be endangered by the traction power supply system.

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

This European Standard applies to all new lines and to all major revisions to existing lines for the following electric traction systems:

- a) railways;
- b) guided mass transport systems such as
 - 1) tramways,
 - 2) elevated and underground railways,
 - 3) mountain railways,
 - 4) trolleybus systems, and
 - 5) magnetically levitated systems, which use a contact line system,
- c) material transportation systems.

This European Standard does not apply to:

- d) mine traction systems in underground mines;
- e) 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 traction power supply system;
- f) suspended cable cars;
- g) funicular railways.

This European Standard does not specify working rules for maintenance.

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.

EN 50119:2009, *Railway applications – Fixed installations – Electric traction overhead contact lines*

EN 50122-2, *Railway applications – Fixed installations – Part 2: Protective provisions against the effects of stray currents caused by d.c. traction systems*

EN 50124-1:2001 + A1:2003 + A2:2005, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

EN 50153:2002, *Railway applications – Rolling stock – Protective provisions relating to electrical hazards*

EN 50163, *Railway applications – Supply voltages of traction systems*

 EN 50345, *Railway applications – Fixed installations – Electric traction – Insulating synthetic rope assemblies for support of overhead contact lines* 

EN 60529:1991 + A1:2000, *Degrees of protection provided by enclosures (IP code)* (IEC 60529:1989 + A1:1999)

EN 60898-1:2003 + A11:2005, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation* (IEC 60898-1:2002, mod.)

EN 61140:2002 + A1:2006, *Protection against electric shock – Common aspects for installation and equipment* (IEC 61140:2001 + A1:2004, mod.)

HD 60364-4-41:2007, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock (IEC 60364-4-41:2005, mod.)*

HD 637 S1:1999, *Power installations exceeding 1 kV a.c.*

IEC 60050-101, *International Electrotechnical Vocabulary – Chapter 101: Mathematics*

IEC 60050-111, *International Electrotechnical Vocabulary – Chapter 111: Physics and chemistry*

IEC 60050-191, *International Electrotechnical Vocabulary – Chapter 191: Dependability and quality of service*

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

IEC 60050-442, *International Electrotechnical Vocabulary – Chapter 442: Electrical accessories*

IEC 60050-811, *International Electrotechnical Vocabulary – Chapter 811: Electric traction*

IEC 60050-821, *International Electrotechnical Vocabulary – Chapter 821: Signalling and security apparatus for railways*

IEC 60050-826, *International Electrotechnical Vocabulary – Chapter 826: Electrical installations*

IEC/TS 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

ISO 3864-1:2002, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas*

ISO 7010:2003 + A1:2006, *Graphical symbols – Safety colours and safety signs – Safety signs used in workplaces and public areas*

3 Terms and definitions

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

3.1 Electrical safety and hazards

3.1.1

electrical safety

freedom from unacceptable risk of harm caused by electrical systems

3.1.2

electric shock

pathophysiological effect resulting from an electric current passing through a human or animal body

[IEC 60050-826-12-01]

3.1.3

(effective) touch voltage (U_{te})

voltage between conductive parts when touched simultaneously by a person or an animal

NOTE 1 The value of the effective touch voltage can be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts

[IEC 60050-195-05-11]

NOTE 2 The conductive path through the body is conventionally from hand to both feet (horizontal distance of 1 m) or from hand to hand.

3.1.4

prospective touch voltage (U_{tp})

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

[IEC 60050-195-05-09]

3.1.5

body voltage (U_b)

product of the current through the body and the body impedance

3.1.6

standing surface

any point on a surface where persons may stand or walk about without great effort

3.1.7

protective boarding

non-conducting barrier to protect persons from coming into direct contact with the live conductor rail

3.1.8

(electrically) protective obstacle

part preventing unintentional direct contact, but not preventing direct contact by deliberate action

[IEC 60050-195-06-16]

3.1.9

(electrically) protective barrier

part providing protection against direct contact from any usual direction of access

[IEC 60050-195-06-15]

3.1.10

anti-trespassing guard

equipment provided to deter entry to a restricted area, structure or building by an unauthorized person

3.1.11

conductive part

part which can carry electric current

[IEC 60050-195-01-06]

3.1.12

exposed conductive part

conductive part of electrical equipment, which can be touched and which is not normally live, but which can become live when basic insulation fails

NOTE A conductive part of electrical equipment which can only become live through contact with an exposed conductive part which has become live is not considered to be an exposed conductive part itself.

[IEC 60050-442-01-21]

3.1.13

live part

conductor or conductive part intended to be energised in normal use. By convention this does not include the running rails and parts connected to them

3.1.14

direct contact

electric contact of persons or animals with live parts

[IEC 60050-826-12-03]

3.1.15

indirect contact

electric contact of persons or animals with exposed conductive parts which have become live under fault conditions

[IEC 60050-826-12-04]

3.1.16

neutral conductor

conductor electrically connected to the neutral point and capable of contributing to the distribution of electric energy

[IEC 60050-826-14-07]

3.1.17

protective conductor (PE)

conductor, required by some measures for protection against electric shock, for electrically connecting any of the following parts:

- exposed conductive parts;
- extraneous conductive parts;
- main earthing terminal;
- earth electrode;
- earthed point of the source or artificial neutral

3.1.18

PEN conductor

conductor combining the functions of both a protective earthing conductor and a neutral conductor

[IEC 60050-826-13-25]

3.1.19

solid-wall design

any kind of construction made of concrete, steel or other material without any holes or gaps

3.1.20

voltage-limiting device (VLD)

protective device whose function is to prevent existence of an impermissible high touch voltage

3.2 Earthing and equipotential bonding

3.2.1

earth

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

[IEC 60050-826-04-01]

3.2.2

earthing

connection of conductive parts to an appropriate earth electrode

3.2.3

earth electrode

conductor or a group of conductors in intimate contact with and providing an electrical connection to earth

[IEC 60050-461-06-18]

3.2.4

structure earth

construction made of metallic parts or construction including interconnected metallic structural parts, which can be used as an earth electrode

NOTE Examples are reinforced railway structures such as bridges, viaducts, tunnels, mast foundations and reinforced track bed.

3.2.5

rail to earth resistance

electrical resistance between the running rails and the earth or structure earth

3.2.6

equipotential bonding

provision of electric connections between conductive parts, intended to achieve equipotentiality

[IEC 60050-826-13-19]

3.2.7

main equipotential busbar (MEB)

busbar where the equipotential conductors terminate

3.2.8

cross bond

electrical connection intended to connect in parallel the conductors of the return circuit

3.2.9

rail-to-rail cross bond

electrical bond that interconnects the running rails of the same track

3.2.10

track-to-track cross bond

electrical bond that interconnects tracks

3.2.11

rail joint bond

conductor ensuring the electrical continuity of rails at a joint

[IEC 60050-811-35-07]

3.2.12

open connection

connection of conductive parts to the return circuit by a voltage-limiting device which makes a conductive connection either temporarily or permanently if the limited value of the voltage is exceeded

3.2.13

common building

building or structure which contains or supports an a.c. railway and a d.c. railway; furthermore where some conductive parts of the structure are within the contact line zone or the current collector zone of the a.c. railway and some conductive parts of the structure are within the contact line zone or the current collector zone of the d.c. railway

NOTE Even the unintended connection of conductive parts of different structures can form a common building, e.g. via reinforcement, wiring, pipes, etc.

3.3 Return circuit

3.3.1

return circuit

all conductors which form the intended path for the traction return current

EXAMPLE The conductors may be:

- running rails,
- return conductor rails,
- return conductors,
- return cables.

3.3.2

track return system

system in which the running rails of the track form a part of the return circuit for the traction current

[IEC 60050-811-35-02]

3.3.3

return conductor

conductor paralleling the track return system and connected to the running rails at periodic intervals

3.3.4

return conductor rail – return current rail

conductor rail used instead of the running rail for the return currents

[IEC 60050-811-34-10]

3.3.5

return cable

conductor connecting the running rails or other parts of the return circuit to the substation

NOTE Similar to IEC 60050-811-35-04.

3.3.6

traction return current

sum of the currents returning to the supply source, the substation or regenerative braking vehicles

3.3.7

rail potential (U_{RE})

voltage occurring between running rails and earth

3.3.8

closed formation

area where the top of the running rails is at the same level as the surrounding surface

3.3.9

open formation

area where the running rails are laid above the surrounding surface

3.3.10

conductance per length G'_{RE}

reciprocal value of the rail to earth resistance per length (S/km)

3.3.11

insulating rail joint

mechanical rail joint which longitudinally separates the rail electrically

3.3.12

track circuit

electrical circuit of which the rails of a track section form a part, with usually a source of current connected at one end and a detection device at the other end for detecting whether this track section is clear or occupied by a vehicle

NOTE In a continuous signalling system, the track circuit may be used to transmit information between the ground and the train.

[IEC 60050-821-03-01]

3.3.13

top of rail level (TOR)

common rail level tangent

3.4 Electric traction system

3.4.1

electric traction system

railway electrical distribution network used to provide energy for rolling stock

NOTE The system may comprise:

- contact line systems;
- return circuit of electric traction systems;
- running rails of non electric traction systems, which are in the vicinity of, and conductively connected to the running rails of an electric traction system;
- electrical installations, which are supplied from contact lines either directly or via a transformer;
- electrical installations in substations, which are utilized solely for distribution of power directly to the contact line;
- electrical installations of switching stations.

3.4.2

(traction) substation

installation to supply a contact line system and at which the voltage of a primary supply system, and in certain cases the frequency, is transformed to the voltage and the frequency of the contact line

3.4.3

(traction) switching station

installation from which electrical energy can be distributed to different feeding sections or from which different feeding sections can be switched on and off or can be interconnected

3.4.4

feeding section

electrical section of the route fed by individual track feeder circuit-breakers within the area supplied by the substation

[EN 50119:2009, 3.3.2]

3.4.5

fault condition

non intended condition caused by short-circuit. The time duration is terminated by the correct function of the protection devices and circuit breakers

NOTE For the relevant fault duration the correct operation of protection devices and circuit breakers is taken into account.

3.4.6

short-circuit

accidental or intentional conductive path between two or more conductive parts forcing the electric potential differences between these conductive parts to be equal to or close to zero

[IEC 60050-195-04-11]

3.4.7

high voltage

nominal voltage exceeding AC 1 000 V or DC 1 500 V

3.4.8

low voltage

nominal voltage up to and including AC 1 000 V or DC 1 500 V

3.4.9

zone of mutual interaction

zone for which a mutual interference between a.c. railway and d.c. railway shall be considered

3.4.10

expected prospective short-circuit current

short-circuit current in d.c. traction systems that it is expected to be reached if the fault is not switched off

3.5 Contact line

3.5.1

contact line system

support network for supplying electrical energy from substations to electrically powered traction units, which covers overhead contact line systems and conductor rail systems; the electrical limits of the system are the feeding point and the contact point to the current collector

NOTE The mechanical system may comprise:

- the contact line,
- structures and foundations,
- supports and any components supporting or registering the conductors,
- head and cross spans,
- tensioning devices,
- along-track feeders, reinforcing feeders, and other lines like earth wires and return conductors as far as they are supported from contact line system structures,
- any other equipment necessary for operating the contact line,
- conductors connected permanently to the contact line for supply of other electrical equipment such as lights, signal operation,
- point control and point heating.

[EN 50119: 2009, 3.1.1]

3.5.2

contact line

conductor system for supplying traction units with electrical energy via current-collection equipment

NOTE This includes all current-collecting conductors and conducting rails or bars, including the following:

- reinforcing feeders;
- cross-track feeders;
- disconnectors;
- section insulators;
- over-voltage protection devices;
- supports that are not insulated from the conductors;
- insulators connected to live parts;

but excluding other conductors, such as the following:

- along-track feeders;
- earth wires and return conductors.

[EN 50119:2009, 3.1.2]

3.5.3

overhead contact line system

contact line system using an overhead contact line to supply current for use by traction units

[EN 50119:2009, 3.1.3]

3.5.4

overhead contact line

contact line placed above (or beside) the upper limit of the vehicle gauge and supplying vehicles with electric energy through roof-mounted current collection equipment

[IEC 60050-811-33-02]

3.5.5

out of running overhead contact line

part of overhead contact line, not intended to be directly used for current collection, e.g. in order to reach a termination point on a mast or a structure

3.5.6

conductor rail system

contact line system using a conductor rail for current collection

[EN 50119:2009, 3.1.5]

3.5.7

conductor rail

contact line made of a rigid metallic section or rail, mounted on insulators located near the running rails

[EN 50119:2009, 3.1.7]

3.5.8

overhead conductor rail

rigid overhead contact line, of simple or composite section, mounted above or beside the upper limit of the vehicle gauge, supplying traction units with electrical energy via roof-mounted current collection equipment

[EN 50119:2009, 3.1.6]

3.5.9

overhead contact line zone (OCLZ)

zone whose limits are in general not exceeded by a broken overhead contact line

3.5.10

current collector zone (CCZ)

zone whose limits are in general not exceeded by an energised collector no longer in contact with the contact line or broken collector and its fragments

3.5.11

contact wire

electric conductor of an overhead contact line with which the current collectors make contact

[IEC 60050-811-33-15]

3.5.12

stagger

displacement of the contact wire away from the track centre line at successive supports, to avoid localised wear of the pantograph wearing strips

[IEC 60050-811-33-21]

3.5.13

feeder

electrical conductor like a cable or overhead line between the contact line and a substation or a switching station which is fed by a circuit breaker

3.5.14

reinforcing feeder

overhead conductor mounted adjacent to the overhead contact line, and directly connected to it at frequent intervals, in order to increase the effective cross sectional area of the overhead contact line

[EN 50119:2009, 3.2.2]

3.5.15

section insulator

sectioning point formed by insulators inserted in a continuous run of a contact line, with skids or similar devices to maintain continuous electrical contact with the collector

3.5.16

double insulation

insulation comprising both basic insulation and supplementary insulation

[IEC 60050-195-06-08]

3.6 Corrosion and corrosion protection

3.6.1

corrosion

electrochemical reaction of a metal with its environment, resulting in its progressive degradation or destruction

NOTE This European Standard deals with corrosion caused by stray currents.

3.6.2

leakage current

current which, in the absence of a fault, flows to earth or to extraneous conductive parts in a circuit

3.6.3

stray current (I_s)

part of the current caused by a d.c.-traction system which follows paths other than the return circuit

3.6.4

cathodic protection

electrochemical immunity produced by an appropriate cathodic polarization

[IEC 60050-111-15-40]

3.7 Current collection

3.7.1

current collection

current transmission from contact line to a vehicle

3.7.2

current collector

equipment fitted to the vehicle and intended to collect current from a contact wire or conductor rail

[IEC 60050-811-32-01]

3.7.3

pantograph

apparatus for collecting current from one or more contact wires, formed of a hinged device designed to allow vertical movement of the pantograph head

[IEC 60050-811-32-02]

3.7.4

shoegear

assembly of parts for collecting current from a conductor rail

[IEC 60050-811-32-19]

3.7.5

trolley

apparatus for collecting current from a contact wire by means of a grooved wheel or contact slipper mounted on a pole which is movable in any direction

[IEC 60050-811-32-08]

3.8 Residual current devices

3.8.1

residual current device (RCD)

mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

NOTE A residual current device can be a combination of various separate elements designed to detect and evaluate the residual current and to make and break current.

[IEC 60050-442-05-02]

3.8.2

residual current operated circuit-breaker without integral overcurrent protection (RCCB)

residual current operated switching device not designed to perform the functions of protection against overloads and/or short-circuits

[IEC 60050-442-05-03]

3.8.3

residual current operated circuit-breaker with integral overcurrent protection (RCBO)

residual current operated switching device designed to perform the functions of protection against overloads and/or short-circuits

[IEC 60050-442-05-04]

3.9 General terms

3.9.1

(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]

3.9.2

authorized trackside walking route

safe path alongside the track for use only by authorized persons

3.9.3

monitoring

activity, performed either manually or automatically, intended to observe the state of an item

NOTE Automatic supervision may be performed internally or externally to the item.

[IEC 60050-191-07-26]

3.9.4

public area

area to which the public has unrestricted access

3.9.5

restricted area

area for which access is only permitted for authorized persons

4 Contact line zone and current collector zone

4.1 Overhead contact line systems

These zones are defined for protective provisions in accordance with 6.3 and are the zones whose limits are in general not exceeded by a broken overhead contact line or an energised dewired or broken current collector and its fragments.

Structures and equipment may accidentally come in contact with a live broken overhead contact line or live parts of a broken or dewired current collector and thereby become live. Figure 1 defines the zone inside which such contact is considered to be probable.

NOTE 1 A current collector which has become disconnected from the overhead contact line due to a mishap may nevertheless be alive if a train has multiple current collectors which are electrically connected or if the train is braking using a regenerative brake.

The parameters X , Y , Z in Figure 1 shall be defined by national regulations.

NOTE 2 A guiding value for the parameter X is given as 4 m, Y is given as 2 m and Z is given as 2 m.

NOTE 3 The stagger has been taken into consideration within the dimension of X .

If the current collector is a pantograph the width of the current collector zone Y is the result of:

- the half width of the pantograph $L_P/2$,
- the lateral movement of the pantograph S_1 ,
- the electrical clearance S_{el} in accordance with EN 50119, and
- a safety distance S_2 for the broken or dewired pantograph.

$$Y = L_P/2 + S_1 + S_{el} + S_2$$

The height of the current collector zone Z depends on:

- the maximum height of the fully uplifted current collector H_{max} measured from the TOR,
- the electrical clearance S_{el} in accordance with EN 50119,
- a safety distance in height S_3 for the broken pantograph.

$$Z = H_{max} + S_{el} + S_3 - HP$$

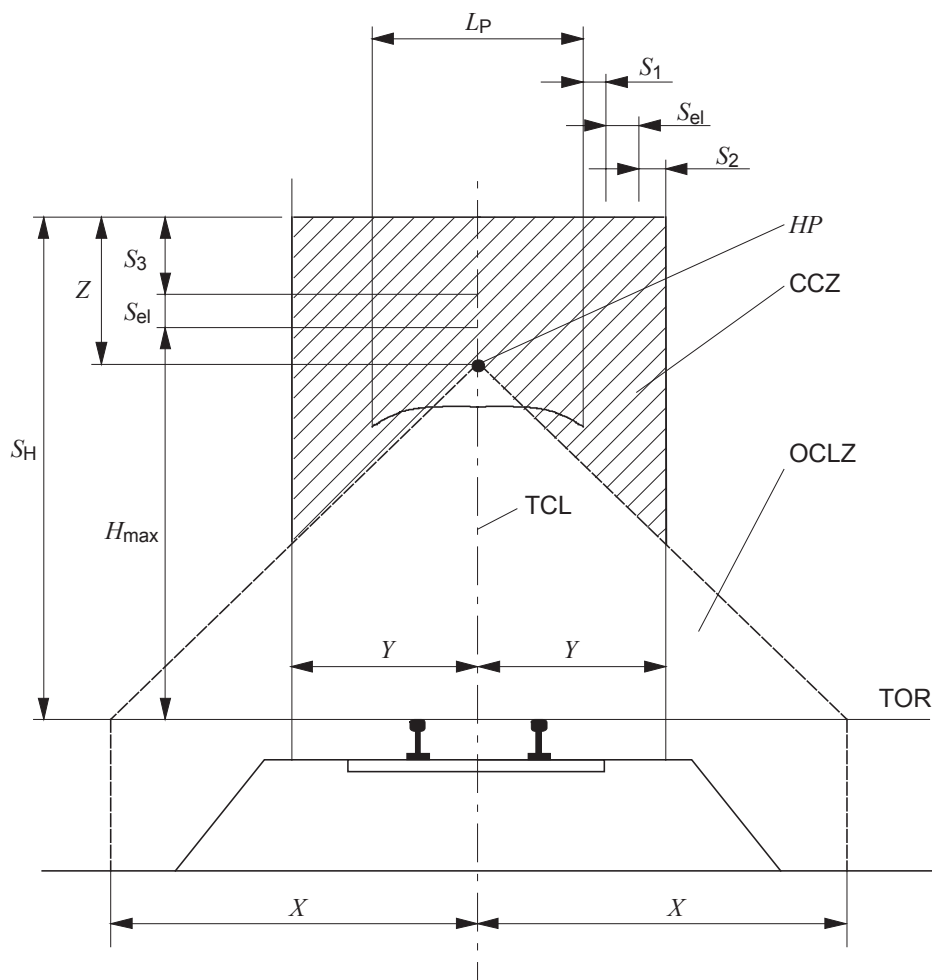
The point HP is the position of the highest conductor of the overhead contact line under all operational conditions considered in the centre of the track. The limits of the overhead contact line zone below TOR are extended vertically downwards until the earth surface is reached.

These limits need not be extended below the upper surface of the deck when the railway runs over a bridge.

In the case of out of running overhead contact lines the overhead contact line zone shall be extended accordingly.

When it can be proved, that it is unlikely that an overhead conductor rail will break and endanger the neighbouring area, an overhead conductor rail zone in this context is not necessary, but a current collector zone is necessary.

The current collector zone for trolleys shall be given in national regulations.



Key

TOR	top of rail
HP	highest point of the overhead contact line
OCLZ	overhead contact line zone
CCZ	current collector zone
TCL	track centre line
X	maximum unidirectional (half) horizontal OCLZ, top of rail level
Y	maximum unidirectional (half) horizontal CCZ
Z	distance between HP and S_H
S_1	width of lateral movement of the current collector
S_2	lateral safety distance for the broken or dewired current collector
S_3	vertical safety distance for the broken or dewired current collector
S_{el}	electrical clearance in accordance with EN 50119
S_H	maximum height of current collector zone
L_P	current collector width
H_{max}	maximum height of the fully uplifted current collector

Figure 1 — Overhead contact line zone and current collector zone

4.2 Conductor rail systems

In the case of a conductor rail close to the running rails, a contact line zone is not required.

NOTE The risk of a broken conductor rail can be neglected.

For provisions against direct contact see 5.5. The limits of the current collector zone shall be stipulated according to each specific case by the infrastructure manager.

4.3 Trolleybus systems

This zone is defined for protective provisions in accordance with 5.6.3 and is the zone whose limits are in general not exceeded by one or both broken overhead contact wire or an energised dewired or broken trolley and its fragments.

Structures and equipment may accidentally come in contact with a live broken overhead contact line or live parts of a broken or dewired trolley and thereby become live. Figure 2 defines the zone inside which such contact is considered to be probable.

The parameters X , Y , Z in Figure 2 shall be defined by national regulations.

NOTE A guiding value for the parameter X is given as 4 m, Y is given as 0,6 m and Z is given as 1 m.

In the case of trolleybuses, the trolley and the current collector head are guided by the contact wire: therefore the parameters L_P and S_1 are zero.

The width of the current collector zone Y is the result of:

- the electrical clearance S_{el} in accordance with EN 50119, and
- a safety distance S_2 for the broken or dewired trolley.

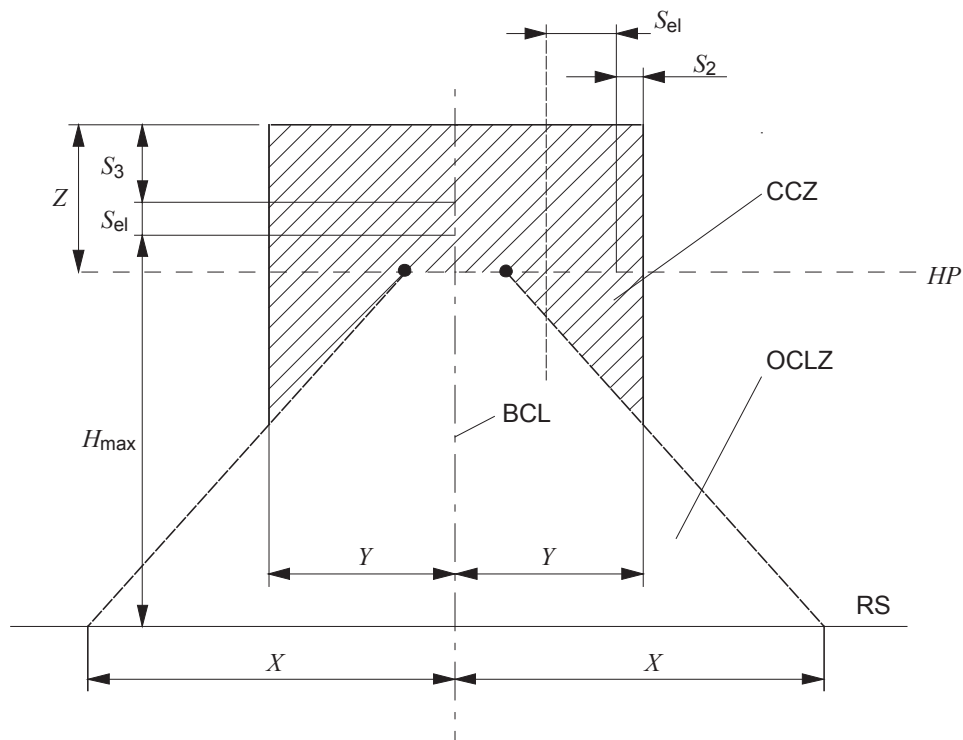
$$Y = S_{el} + S_2$$

The height of the current collector zone Z depends on:

- the maximum height of the fully uplifted trolley H_{max} measured from the road surface;
- the electrical clearance S_{el} in accordance with EN 50119;
- a safety distance in height S_3 for the broken current collector.

$$Z = H_{max} + S_{el} + S_3 - HP$$

The point HP is the position of the highest conductor of the overhead contact line under all operational conditions. The limits of the overhead contact line zone need not be extended beyond the upper surface of the deck when the trolleybus-line runs over a bridge.



Key

<i>HP</i>	highest point of the overhead contact line
<i>RS</i>	road surface
<i>OCLZ</i>	overhead contact line zone
<i>CCZ</i>	current collector zone
<i>BCL</i>	bifilar centre line
<i>X</i>	maximum unidirectional (half) horizontal OCLZ, top of road surface
<i>Y</i>	maximum unidirectional (half) horizontal CCZ
<i>Z</i>	distance between <i>HP</i> and <i>S_H</i>
<i>S₂</i>	lateral safety distance for the broken or dewired current collector
<i>S₃</i>	vertical safety distance for the broken or dewired current collector
<i>S_{el}</i>	electrical clearance in accordance with EN 50119
<i>S_H</i>	maximum height of current collector zone
<i>H_{max}</i>	maximum height of the fully uplifted current collector

Figure 2 — Overhead contact line zone and current collector zone for trolley bus systems