SLOVENSKI STANDARD
oSIST prEN 50367:2009

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Ģelezniġke naprave - Sistemi za odjem toka - Tehniļ ni kriteriji za interaktivnost med odjemnikom toka in kontaktnim vodnikom (za doseganje prostega dostopa)

Railway applications - Current collection systems - Technical criteria for the interaction between pantograph and overhead line (to achieve free access)

Bahnanwendungen - Zusammenwirken der Systeme - Technische Kriterien für das Zusammenwirken zwischen Stromabnehmer und Oberleitung für einen freien Zugang

Applications ferroviaires - Systèmes de captage de courant - Critères techniques d'interaction entre le pantographe et la ligne aérienne de contact (réalisation du libre accès)

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This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
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It has been drawn up by CLC/SC 9XC.

If this draft becomes a European Standard, 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.

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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 draft 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 is submitted to the CENELEC enquiry.

This document will supersede EN 50367:2006.

This draft 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 and 2001/16/EC. See Annex ZZ.

Contents

Figures

Tables

1 Scope

Combination of different overhead contact lines and pantographs will provide various interaction performances.

This standard defines parameters for interoperability in the field of interaction between pantograph and overhead contact line. The document specifies the interface requirements of rolling stock and infrastructure to achieve free access to the European railway network.

This standard describes parameters and values for all planned lines and future lines.

Annex B gives some essential parameters for existing lines.

The energy supply system is not covered by this standard.

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.

96/48/EC	*EU council directive on the interoperability of the trans-European high speed rail system TSI sub-system Energy, Official Journal L 235 , 17/09/1996 p. 0006 – 0024*
2001/16/EC	*Directive of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system, Official Journal L 110, 20/04/2001 p. 0001 – 0027*
2004/50/EC	*Directive of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system, Official Journal L 164/114 29/04/2004 p. 0001 - 0050*
2007/32/EC	*Directive of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system, Official Journal L 141, 02/06/2007, p. 0063–0066*
EN 50119:200X [1)]	*Railway applications – Fixed installations – Electric traction overhead contact lines*
EN 50149:2001	*Railway applications – Fixed installations – Electric traction – Copper and copper alloy grooved contact wires*
EN 50163:2004	*Railway applications – Supply voltages of traction systems*
EN 50206-1:1998 EN 50206-1:200X [2)]	*Railway applications – Rolling stock – Pantographs: Characteristics and tests – Part 1: Pantographs for main line vehicles*
EN 50317:2002 + A1:2004 + A2:2007	*Railway applications – Current collection systems – Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line*
EN 50318:2002	*Railway applications – Current collection systems – Validation of simulation of the dynamic interaction between pantograph and overhead contact line*

1) To be published.

2) At draft stage.

EN 50388:2005 EN 50388:200X [2)]	*Railway applications – Power supply and rolling stock – Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*
EN 50405:2006	*Railway applications – Current collection systems – Pantographs, testing methods for carbon contact strips*
EN 15273:200X series [1)]	*Railway applications – Gauges*
IEC 60050-811:1991	*International Electrotechnical Vocabulary – Chapter 811: Electrical traction*

3 Definitions

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

3.1
contact force
vertical force applied by the pantograph to the overhead contact line. The contact force is the sum of forces of all contact points
[EN 50317:2002]

3.2
static contact force
mean vertical force exerted upwards by the pantograph head on the overhead contact line, and caused by the pantograph-raising device, whilst the pantograph is raised and the vehicle is at standstill
[EN 50206-1:1998]

3.3
mean contact force (F_m)
statistical mean value of the contact force
[EN 50317:2002]

3.4
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
neutral section
section of a contact line provided with a sectioning point at each end to prevent successive electrical sections, differing in voltage, phase or frequency being connected together by the passage of current collectors
[IEC 60050-811-36-16]

3.6
nominal voltage
voltage by which an installation or part of an installation is designated
[EN 50163:2004]

3.7
contact wire height
distance from the top of the rail to the lower face of the contact wire, measured perpendicular to the track
[EN 50119:200X (omitting references to trolley buses)]

3.8
minimum contact wire height
minimum value of the contact wire height in the span in order to avoid the arcing between one or more contact wires and the vehicles in all conditions
[EN 50119:200X]

3.9
nominal contact wire height
a nominal value of the contact wire height at a support in the normal conditions
[EN 50119:200X]

3.10
maximum contact wire height
maximum possible contact wire height which the pantograph is required to reach, in all cases
[EN 50119:200X]

3.11
automatic dropping device
device that lowers the pantograph in the event of pantograph head failure or damage of the pantograph head
[EN 50206-1:1998]

3.12
arcing
flow of current through an air gap between a contact strip and a contact wire usually indicated by the emission of intense light
[EN 50317:2002]

3.13
percentage of arcing
percentage given by the following formula:

$$NQ = \frac{\sum t_{arc}}{t_{total}} \times 100$$

where

t_{arc} is the duration of an arc lasting longer 5 ms;

t_{total} is the measuring time with a current greater than 30 % of the nominal current.

The result, given in %, is a characteristic for a given speed of the vehicle
[EN 50317:2002]

3.14
maximum length of pantograph head
maximum distance measured along the axis of the track between the outer edges of the contact strips

3.15
kinematics envelope
maximum envelope of the pantograph head under all operating conditions

NOTE Additional information is given in EN 15273-1:200X [3], Clause 3.

[3] At draft stage.

3.16
skew of pantograph head
vertical distance between the highest point of the pantograph head and the contact point

NOTE Additional information is given in EN 15273-1:200X, Figure 44.

3.17
contact point
point of the mechanical contact between a contact strip and a contact wire
[EN 50317:2002]

4 Symbols and abbreviations

C	length of common part
D	overall length of neutral section
D'	length of neutral zone
d	length of insulator inserted in contact wire
F_m	mean contact force
F_{max}	maximum contact force
F_{min}	minimum contact force
GC	gauge C according EN 15273:200X series
b_w	half width of pantograph bow
b_1	kinematic range at a contact wire height of 5,0 m
b_2	kinematic range at the actual contact wire height
L	distance between closest pantographs
L'	distance covered by farthest pantographs
L''	distance between 3 consecutive pantographs
l	maximum width
NQ	percentage of arcing
σ_{max}	maximum standard deviation of contact force

5 Geometry

5.1 General

The infrastructure manager shall ensure that the values for the geometric characteristics of the overhead contact line are as shown in Table 1.

The pantographs of the train shall fulfil the geometric characteristics as shown in Table 2, according to the type of infrastructure on which it will circulate under the rules of free access.

5.2 Overhead contact line characteristics

For free access the parametric requirements to achieve interaction that are dependent on the geometry of the overhead contact line (see EN 50119:200X) are as follows:

- gauge;
- contact wire height;
- permissible contact wire gradient;
- permissible lateral deviation of the contact wire from the track centre line under action of a crosswind;
- limit for free and unrestricted contact wire uplift at the support;
- neutral section.

The overhead contact line shall conform to EN 50119:200X.

5.2.1 Gauges

The design of overhead contact line system shall allow the operation of vehicles complying with gauges as defined in EN 15273:200X series.

5.2.2 Contact wire height

Range of nominal contact wire height shall be in accordance with Table 1.

Minimum contact wire height shall be calculated in accordance with EN 50119:200X, 5.10.4.

The maximum contact wire height is 6,5 m.

Table 1 – Overhead contact line characteristics for AC and DC systems

Line speed km/h	$v \leq 200$	$200 < v < 250$	$v \geq 250$
Range of nominal contact wire height	5,0 up to 5,75	5,0 up to 5,5	5,08 up to 5,3
Dimensions in metres.			

5.2.3 Contact wire gradient

The permissible contact wire gradient is defined in EN 50119:200X, 5.10.3.

5.2.4 Lateral deviation

The wind speed and the pantograph length to be considered will be defined by the infrastructure manager.

Maximum lateral deviation of the contact wire from the track centre line under action of a crosswind is calculated for pantographs 1 950 mm, 1 600 mm.

The permissible contact wire deviation under the action of a cross wind shall be calculated for contact wire heights above 5 300 mm and/or on curved track. It shall be calculated using the half-width of the dynamic envelope of the European pantograph passage, b_2. b_2 shall be calculated in accordance with A.3:

- the smaller value of either 0,4 m or (1,4 – b_2) m [a] 1 600 mm pantograph;
- the smaller value of either 0,55 m or (1,7 – b_2) m 1 950 mm pantograph.

5.2.5 Contact wire uplift

The requirements for the allowance for contact wire uplift at the support are defined in EN 50119:200X, 5.10.2.

5.2.6 Neutral section

The functional requirements of neutral sections are defined as follows:

- trains shall be able to move from one section to an adjacent one (which is fed from a different phase or system) without bridging the neutral section;
- the neutral section shall be designed in such a way that trains with several pantographs at an overall distance of maximum 400 m can cross with their pantographs up;
- power consumption of the train shall be brought to zero when entering the phase separation section. See also EN 50388:2005;
- the infrastructure manager shall provide adequate means to allow a train that stops underneath the phase separation section to restart;
- in the case of trains with several pantographs, the pantographs shall be lowered for the entire length of the neutral section if some of the above requirements cannot be met. Technical or operational measures shall be taken to meet safety and availability requirements.

For compatibility between neutral sections and pantographs arrangement, see 5.2 and A.1.

5.3 Pantograph characteristics

The geometry of the pantograph is characterised by the following major interaction parameters:

- geometric profile of pantograph bow;
- range of working height;
- length of contact strips;
- maximum width;
- skew of pantograph bow.

For a current collection without interruption, functional requirements are described in this clause. These requirements are related to the geometric profile of the pantograph bow and to the dynamic behaviour of the vehicle (i.e. kinematics envelope) and ensure that at least one contact wire is always inside the conducting range of pantograph bow (including all tolerances).

The permissible value for the skew of pantograph bow is 60 mm, with the contact point at the limit of the contact strip.

The maximum lateral deviation of the European pantograph bow is specified in A.3.

Additional characteristics, related to the train, shall also be implemented as follows:

- automatic dropping device;
- minimum and maximum spacing between two operating pantographs;
- an electrical connection between operating pantographs in AC systems shall not be used;
- lowering times under normal conditions; From the moment of initiation, the pantograph shall lower to the minimum dynamic electrical clearance in less than 3 s. The pantograph shall lower to the housed position in less than 10 s. The circuit breaker shall be opened before lowering pantograph.

NOTE 1 The limits for maximum width are important for the correct operation of sectioning devices. The limits for distances between operating pantographs are important for the correct operation of neutral sections. See A.1.

NOTE 2 For DC systems, when an electrical connection between operating pantographs exists, a device to interrupt this connection should be provided.

The design of the pantograph shall ensure performance in accordance with Clause 7 for the speed range and a contact wire height according to Table 2 and Table 3. The maximum value of working height shall be 6,5 m.

For compatibility between pantographs arrangement and neutral sections, see A.1.

Table 2 – Pantograph characteristics for AC and DC systems

Category	$v < 200$	$v \geq 200$
Profile of pantograph bow [a]	See Figure A.7 and Figure A.8	See Figure A.7
Maximum length of pantograph bow (m) [b]	0,65	0,65
Automatic dropping device	Necessary [c]	Necessary
Minimum and maximum spacing between two operating pantographs (m)	See A.1	See A.1
Maximum skew of pantograph bow (mm)	60	60
Maximum lateral deviation of the interoperable pantograph head	See A.3	See A.3

[a] See Figures B.2 to B.8 for the national profiles for existing lines.

[b] Maximum length of pantograph bow, see A.1.

[c] For v_{max} < 100 km/h only recommendation.

The pantograph shall conform to EN 50206-1:1998.

6 Material interfaces

6.1 General

The wear of contact wire and contact strips as well as the permissible current at the contact point depends significantly on the materials of these two components. In order to achieve a satisfactory performance the characteristics of contact wire and contact strips shall be in accordance with 6.2 and 6.3.