SLOVENSKI STANDARD
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SIST EN 50367:2012
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Železniške naprave - Sistemi za odjem toka - Tehnični 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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English Version

Railway applications - Fixed installations and rolling stock - Criteria to achieve technical compatibility between pantographs and overhead contact line

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

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

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European foreword

This document (EN 50367:2020) 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)	2021-07-27
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2023-07-27

This document supersedes EN 50367:2012 and all of its amendments and corrigenda (if any).

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

Annex B gives some parameters for existing lines (informative).

Compared with the previous version, the most significant changes in this version are:

- Update of definitions;
- Changes to 5.2.5 concerning the lateral deviation on the basis of RfS 51 from the European Union Agency for Railways;
- Changes in 5.2.7;
- Revision of 5.3.2, including update of figures;
- Improvement of testing method for DC contact strips: 6.3, A.3;
- Addition of tunnel requirements in Clause 7;
- Revision of Table 9;
- Assessment requirements in Clause 9;
- Addition of an introduction for Annex B;
- Addition of Annex C;
- Addition of Annex D.

1 Scope

This document specifies requirements for the technical compatibility between pantographs and overhead contact lines, to achieve free access to the lines of the European railway network.

NOTE These requirements are defined for a limited number of pantograph types conforming to the requirements in 5.3, together with the geometry and characteristics of compatible overhead contact lines.

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 15273-1:2013+A1:2016, *Railway applications - Gauges - Part 1: General - Common rules for infrastructure and rolling stock*

EN 15273-2:2013+A1:2016, *Railway applications - Gauges - Part 2: Rolling stock gauge*

EN 15273-3:2013+A1:2016, *Railway applications - Gauges - Part 3: Structure gauges*

EN 50119:2020, *Railway applications - Fixed installations - Electric traction overhead contact lines*

EN 50125-2:2002, *Railway applications - Environmental conditions for equipment - Part 2: Fixed electrical installations*

EN 50149:2012, *Railway applications - Fixed installations - Electric traction - Copper and copper alloy grooved contact wires*

EN 50206-1:2010, *Railway applications - Rolling stock - Pantographs: Characteristics and tests - Part 1: Pantographs for main line vehicles*

EN 50317:2012, *Railway applications - Current collection systems - Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line*

EN 50318:2018, *Railway applications - Current collection systems - Validation of simulation of the dynamic interaction between pantograph and overhead contact line*

EN 50388:2012, *Railway Applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*

EN 50405:2015, Railway applications – Current collection systems – Pantographs, testing methods for contact strips[1)]

IEC 60050-811:2017, *International Electrotechnical Vocabulary (IEV) - Part 811: Electric traction*

[1)] This standard is impacted by EN 50405:2015/A1:2016.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-811:2017 and the following apply.

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

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

3.1
arcing
flow of current through an air gap between a contact strip and a contact wire usually indicated by the emission of intense light

[SOURCE: EN 50317:2012, 3.17]

3.2
pantograph dropping device
device intended to lower the pantograph automatically if it is damaged

Note 1 to entry: The damage can include the contact strip, the pantograph head and other parts of the pantograph.

[SOURCE: IEC 60050-811:2017, 811-32-22, modified – In the Note 1 to entry, “and” between “strip” and “the pantograph” has been replaced by a comma, and the comma between “and” and “other” has been removed]

3.3
contact force
<for a pantograph> vertical force applied by the pantograph to the contact wire(s)

Note 1 to entry: The contact force is the sum of forces of all contact points of a pantograph.

Note 2 to entry: The contact force is measured perpendicular to the contact plane.

[SOURCE: EN 50318:2018, 3.2, modified – The Note 2 to entry has been added]

3.4
contact plane
plane parallel to the base frame of the pantograph at the contact point

3.5
contact point
<for a pantograph> point of the mechanical contact between a contact strip and a contact wire

[SOURCE: EN 50317:2012, 3.2, modified – The specific domain has been added in the definition]

3.6
contact wire height
distance from the top of the rail level to the lower face of the contact wire.

Note 1 to entry: The contact wire height is measured perpendicular to the track surface.

[SOURCE: IEC 60050-811:2017, 811-33-62, modified – “or road surface for trolleybus (811-02-43) has been removed. In the Note 1 to entry, “or road” has been removed]

3.7
pantograph head
part of the pantograph comprising the contact strips and their mountings, horns and possibly a suspension

[SOURCE: IEC 60050-811:2017, 811-32-05]

3.8
continuous pantograph head profile
pantograph head with collector strips and horns suspended in one piece

3.9
encroachment of the pantograph head
perpendicular distance from the contact plane to the highest point of the pantograph head

Note 1 to entry: Additional information is given in EN 15273-1:2013+A1:2016, Figure 46.

3.10
maximum contact wire height
maximum value of the contact wire height above rail level occurring in any possible case during the lifetime of the overhead contact line

[SOURCE: IEC 60050-811:2017, 811-33-65]

3.11
maximum design contact wire height
maximum theoretical contact wire height not including tolerances and uplift, which the pantograph is required to reach

3.12
maximum width of pantograph head
maximum distance measured along the axis of the track between the outer edges of the contact strips

3.13
mean contact force
F_m
statistical mean value of the contact force

Note 1 to entry: F_m is formed by the static and aerodynamic components of the pantograph contact force.

Note 2 to entry: This mean value can be assessed by simulation or measurement over a specified time or distance.

[SOURCE: EN 50317:2012, 3.5, modified – The Note 2 to entry has been added]

3.14
mechanical kinematic pantograph gauge
gauge of the pantograph head under all operating conditions

Note 1 to entry: Additional information is given in EN 15273-1:2013+A1:2016, 3.23.

3.15
minimum contact wire height
minimum value of the contact wire height above rail level occurring in any possible case during the lifetime of the overhead contact line

[SOURCE: IEC 60050-811:2017, 811-33-64]

3.16
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 pantographs

[SOURCE: IEC 60050-811:2017, 811-36-16, modified - “current collectors” has been replaced by “pantographs”]

3.17
nominal contact wire height
nominal value of the contact wire height above rail level at a support in the normal conditions

[SOURCE: IEC 60050-811:2017; 811-33-63]

3.18
non-continuous pantograph head profile
pantograph head with collector strips separately (independently) suspended from the other parts of the pantograph head

3.19
overhead contact line
contact line placed above the upper limit of the vehicle gauge and supplying vehicles with electric energy through pantographs

[SOURCE: IEC 60050-811:2017, 33-02, modified – “or beside” has been removed and “roof-mounted current collection equipment” has been replaced by “pantographs”]

3.20
percentage of arcing
NQ
proportion of driving time with arcing

[SOURCE: EN 50317:2012, 3.20]

3.21
static contact force
vertical force exerted upward by the pantograph head on the overhead contact line at standstill

[SOURCE: EN 50206-1:2010, 3.3.5, modified - “collector head” has been replaced by “pantograph” and “system” has been removed]

3.22
transition zone
<of pantograph head> range for the transition point between non-independently suspended parts and independently suspended parts of the pantograph head

Note 1 to entry: This concept is illustrated in Figures 1 and 2 of this document

3.23
working range of the height of pantograph
range of permissible heights of contact points in relation to the track level

3.24
limit of dewirement
b_V
maximum permissible lateral deviation of contact wire position from pantograph head centre to prevent dewirement (limit of stability for lateral interaction between contact wire and pantograph, described by the transition point at head profile, where the angle exceeds 40°)

Note 1 to entry: Dewirement (i.e. lateral contact loss between contact wire and pantograph head) is not the only cause of pantograph head / overhead contact line incidents. Other phenomena can lead to incidents, without exceeding dewirement limits, as described now in this document.

3.25
working zone of pantograph head
lateral range of the contact point at the pantograph head for operation under normal conditions (serviceability)

3.26
reference height
<of contact point> height of the contact point used for calculation of lateral position of contact wire at the pantograph head

3.27
traction unit
locomotive, motor coach or train-unit

Note 1 to entry: A train can be formed with multiple traction units.

[SOURCE: IEC 60050-811:2017, 811-02-04, modified – The Note 1 to entry has been added]

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

A	inner distance between the contact strips on successive operational pantograph heads [m]
A'	outer distance between the contact strips on the first and last operational pantograph heads [m]
A''	inner distance between the contact strips of one and the second following operational pantograph head [m]
AC	Alternating Current
$b'_{h,mec}$	width of mechanical kinematic pantograph gauge at reference height for interaction between contact wire and pantograph [m] (inclusive of tolerances of overhead contact line)
$b'_{o,mec}$	width of mechanical kinematic pantograph gauge at maximum verification height of the pantograph gauge in a raised position [m] (inclusive of tolerances of overhead contact line)
$b'_{u,mec}$	width of mechanical kinematic pantograph gauge at minimum verification height of the pantograph gauge in a raised position [m] (inclusive of tolerances of overhead contact line)
$b'_{h,OCL}$	width of mechanical kinematic gauge for serviceability of overhead contact line at reference height for interaction between contact wire and pantograph [m]
$b'_{u,OCL}$	width of mechanical kinematic gauge for serviceability of overhead contact line at minimum verification height of the pantograph gauge in a raised position [m]
b_V	maximum permissible lateral deviation of contact wire position from pantograph head centre to prevent dewirement [m]
b_W	half-length of the pantograph head [m]

$b_{w,c}$	half-length of the pantograph head conducting length (with insulating horns) or working length (with conducting horns) [m]
CL	Conventional Line
d	dimension over wheel flanges at wear limit measured 10 mm below the wheel tread [m]
d_{cant}	lateral movement of contact wire caused by forces from tilted pantograph due to tracks with cant [m]
d_{instl}	tolerance of static lateral position of contact wire [m]
d_{instv}	tolerance of static vertical position of contact wire [m]
d_l	permissible lateral deviation of contact wire from track centre line [m]
d_{lstab}	permissible lateral deviation of contact wire from track centre for stability against dewirement [m]
d_{lserv}	permissible lateral deviation of contact wire from track centre line to meet the serviceability limit state [m]
d_{meas}	tolerance of measurement, measuring errors refer to lateral position of contact wire [m]
d_{pole}	lateral deviation of contact wire position resulting from change of pole deflection under additional load due to wind speed, for serviceability at nominal contact wire height [m]
d_{supp}	lateral deviation of contact wire position resulting from movement of cantilever for change in wire temperature [m]
d_{tens}	lateral deviation of contact wire position resulting from reduced tension force of wires considering efficiency of tensioning devices [m]
D	overall length of neutral section as distance between adjacent systems/phases including overlapping parts taking into account the uplift by pantograph passage and electrical clearances in accordance with EN 50119:2020, 5.1.3 [m]
DI'_o	reference cant, which is the maximum value from cant and cant deficiency [m]
D'	length of neutral section excluding overlapping parts taking into account the uplift by pantograph passage and electrical clearances in accordance with EN 50119:2020, 5.1.3 [m]
D_0	fixed cant value defined taken into account kinematic gauge [m]
DC	Direct Current
e_{po}	offset of the pantograph at the upper verification point [m]
e_{pu}	offset of the pantograph at the lower verification point [m]
e_{phref}	pantograph sway at the reference height for interaction between contact wire and pantograph [m]
F_m	mean contact force [N]
F_{max}	maximum contact force [N]
$F_{m,\ min}$	minimum mean contact force [N]
$F_{m,\ max}$	maximum mean contact force [N]
F_{min}	minimum contact force [N]
F_{stat}	static contact force [N]
f_s	maximum uplift of contact wire within the span length [m]
h_{c0}	value of roll centre height used as interface between the rolling stock and the infrastructure [m]

h_{nom}	nominal contact wire height [m]
h'_o	maximum verification height of the pantograph gauge in a raised position [m]
h'_u	minimum verification height of the pantograph gauge in a raised position [m]
h_{ref}	reference height for interaction between contact wire and pantograph [m]
HSL	High Speed Line
l'_0	fixed cant deficiency value taken into account as interface between the rolling stock and the infrastructure with regard to the kinematic gauge of the pantographs [m]
k'	factor of safety to take into account track irregularities, for pantograph gauge being considered
K_{eff}	efficiency of tensioning devices
l	maximum width of pantograph head [m]
l_{max}	maximum track gauge [m]
L_{sp}	maximum design span length of overhead contact line [m]
NQ	percentage of arcing
$qs'_{i/a}$	displacement due to the quasi-static roll, as maximum from the values to inside and outside the curve, for pantograph gauges [m]
OCL	overhead contact line
Q_{wc}	wind load on catenary [N]
R	horizontal curve radius [m]
S_c	sum of tension forces of catenary and contact wires [N]
$S'_{i/a}$	displacement due to additional overthrow as maximum from the values to inside and outside the curve, for pantograph gauges [m]
s'_0	flexibility coefficient taken into account as interface between the rolling stock and the infrastructure for the pantograph gauge
T_{charge}	angle of dissymmetry, considered in η for poor load distribution [degree]
T_D	track cross-level difference between two maintenance periods [m]
T_{osc}	cross-level difference selected for calculation of oscillations caused by track irregularities [m]
T_{susp}	angle of dissymmetry, considered in η for poor suspension adjustment [degree]
T_{voie}	transverse displacement of the track between two periods of maintenance [m]
d_{up}	lateral movement of contact wire caused by forces from non-horizontal sections of pantograph head [m]
v	permitted train speed with a specific overhead contact line [km/h]
w	distance between parts of different potentials of insulator inserted in contact wire [m]
σ_{max}	maximum standard deviation of contact force
α	angle of independent suspended part of the pantograph head at the transition point [degree]
β	angle of the main horn on the fixed part of the pantograph head [degree]
γ	angle of the horn of the pantograph head [degree]
η	reference value for angle of dissymmetry of a vehicle due to suspension adjustment and to unequal load distributions [degree]