SIST

SLOVENSKI STANDARD
oSIST prEN 50388:2008

01-december-2008

Ģelezniģke naprave - Preskrba z elektriļ no energijo in vozna sredstva - Tehniļ na merila za uskladitev med elektronapajalnimi postajami in elektrovleļ nimi vozili za doseganje interoperabilnosti

Railway applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability

Bahnanwendungen - Bahnenergieversorgung und Fahrzeuge - Technische Kriterien für die Koordination zwischen Anlagen der Bahnenergieversorgung und Fahrzeugen zum Erreichen der Interoperabilität

Applications ferroviaires - Alimentation électrique et matériel roulant - Critères techniques pour la coordination entre le système d'alimentation (sous-station) et le matériel roulant pour réaliser l'interopérabilité

Ta slovenski standard je istoveten z: **prEN 50388:2008**

ICS:

29.280	Elektriļ na vleļ na oprema	Electric traction equipment
45.060.01	Železniška vozila na splošno	Railway rolling stock in general

oSIST prEN 50388:2008 **en,fr**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT prEN 50388

October 2008

ICS

Will supersede EN 50388:2005

English version

Railway applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability

Applications ferroviaires -
Alimentation électrique et matériel roulant -
Critères techniques pour la coordination entre le système d'alimentation (sous-station) et le matériel roulant pour réaliser l'interopérabilité

Bahnanwendungen -
Bahnenergieversorgung und Fahrzeuge -
Technische Kriterien für die Koordination zwischen Anlagen der Bahnenergieversorgung und Fahrzeugen zum Erreichen der Interoperabilität

This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
Deadline for CENELEC: 2009-03-13.

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.

This draft European Standard was established by CENELEC 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 Central Secretariat has the same status as the official versions.

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

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Project: 17184

Ref. No. prEN 50388:2008 E

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 also concerns the expertise of SC 9XB, Electromechanical material on board of rolling stock. It is submitted to the CENELEC enquiry.

This document will supersede EN 50388:2005.

For TSI lines, modification and amendments shall be made within a procedure which is related to the legal status of the HS and CR TSIs.

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 [1)] and 2001/16/EC [2)]. See Annex ZZ.

---

1) Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high speed rail system, O.J. L 235, 17/09/1996, p. 6 – 24

2) Directive 2001/16/EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the trans-European conventional rail system, O.J. L 110, 20/04/2001, p. 1 – 27

Contents

Figures

Tables

1 Scope

This European Standard is intended to be used to set up the requirements for the acceptance of rolling stock on infrastructure in the field of

– co-ordination of protection principles between power supply and traction units, especially fault discrimination for short-circuits,

– co-ordination of installed power on the line and power demand of the trains,

– co-ordination of traction unit regenerative braking and power supply receptivity,

– co-ordination of harmonic behaviour.

This standard deals with the definition and quality requirements of the power supply at the interface between traction unit and fixed installations.

The standard specifies the interface between rolling stock and electrical fixed installations for traction, in the frame ”supply system“. The interaction between pantograph and overhead line is dealt with in EN 50367. The interaction with subsystem “control-command” (especially signalling) is not dealt with in the standard.

Requirements are given for the following categories of line:

– TSI lines (high speed and conventional);

– classical lines.

For classical lines, values, if any, are given for the existing European networks. A set of values is also specified for the future network, which is named ”target“ network.

The following electric traction systems are concerned:

– railways;

– guided mass transport systems that are integrated with the railways;

– material transport systems that are integrated with the railways.

This standard does not apply retrospectively to rolling stock already accepted by infrastructure managers. However, on new infrastructure, existing rolling stock may be accepted by the infrastructure manager, provided there is an agreement.

Information is given to the train operating companies on electrification parameters to enable them to confirm after consultation with the rolling stock manufacturers that there will be no consequential disturbance on the electrification system.

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 50122-2:1998, *Railway applications – Fixed installations – Part 2: Protective provisions against the effects of stray currents caused by d.c. traction systems*

EN 50122-2 [3)], *Railway applications – Fixed installations – Electrical safety, earthing and bonding – Part 2: Provisions against the effects of stray currents caused by d.c. traction systems*

EN 50122-3 [3)], *Railway applications – Fixed installations – Electrical safety, earthing and bonding – Part 3: Mutual interaction of a.c. and d.c. traction systems*

EN 50123-1:2003, *Railway applications – Fixed installations – D.C. switchgear, Part 1: General*

EN 50163:2004 + A1:2007, *Railway applications — Supply voltages of traction systems*

EN 50367, *Railway application — Current collection systems — Technical criteria for the interaction between pantograph and overhead line (to achieve free access)*

IEC 60050-811, *International Electrotechnical vocabulary (IEV) – Chapter 811: Electric traction*

EN ISO 3166-1:1997 [4)], *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes* (ISO 3166-1:1997)

3 Terms and definitions

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

3.1
TSI line
line defined as part of the Trans European High-Speed rail network for the High Speed Technical Specification for Interoperability, HS TSI, (see Directive 96/48/EC) or line defined as conventional as part of TEN Trans European Network in the conventional TSI, CR TSI, (see Directive 2001/16/EC).

It includes for the HS TSI:

– category I: specially built high-speed lines equipped for speeds generally equal to or greater than 250 km/h;
– category II: specially upgraded high-speed lines equipped for speeds of the order of 200 km/h;
– category III: specially upgraded high-speed lines which have special features as a result of topographical, relief or town planning constraints on which the speed must be adapted to each case.

It includes for the CR TSI:

– category IV: New Core TEN LINE:
    – passenger and mixed traffic: 200 km/h max.;
    – freight traffic: 140 km/h max.;

3) At draft stage.

4) Superseded by EN ISO 3166-1:2006, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes* (ISO 3166-1:2006).

- category V: Upgraded Core TEN LINE:
  - passenger and mixed traffic: 160 km/h max.;
  - freight traffic: 100 km/h max.;
- category VI: New Other TEN LINE:
  - passenger and mixed traffic: 140 km/h max.;
  - freight traffic: 100 km/h max.;
- category VII: Upgraded Other TEN LINE:
  - passenger and mixed traffic: 120 km/h max.;
  - freight traffic: 100 km/h max.

3.2
classical line
line which does not belong to the TSI lines.

It includes

- information on European networks named with their national country code (see EN ISO 3166-1) and
- future target network named as ”target“, see 3.25

3.3
type of line
classification of lines as a function of the parameters described in 3.4 to 3.6

3.4
train power at the pantograph
active power of the train taking into account power for traction, regeneration and auxiliary

3.5
minimum possible headway
interval at which trains can run as allowed by the signalling system

3.6
maximum line speed
speed for which the line was approved for operation

3.7
contact line
conductor system for supplying electric energy to vehicles through current-collecting equipment

[IEC 60050-811-33-01]

3.8
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]

3.9
(traction) substation
installation, the main function of which is to supply a contact line system, at which the voltage of a primary supply system, and in certain cases the frequency, is converted to the voltage and frequency of the contact line

3.10
total power factor λ

$$\lambda = \frac{active\ power}{apparent\ power}$$

3.11
deformation factor υ

$$\upsilon = \frac{\lambda}{\cos\varphi}$$

3.12
power factor

$$\cos\varphi = \frac{active\ power\ of\ the\ fundamental\ wave}{apparent\ power\ of\ the\ fundamental\ wave}$$

In this standard, only fundamental wave is considered

NOTE This is also the displacement factor cos φ.

3.13
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]

3.14
vehicle
general term denoting any single item of rolling stock, e.g. a locomotive, a coach or a wagon

[IEC 60050-811-02-02]

3.15
traction unit
general term covering a locomotive, motor coach or train unit

[IEC 60050-811-02-04]

3.16
rolling stock
general term covering all vehicles with or without motors

[IEC 60050-811-02-01]

3.17
train
any combination of rolling stock coupled together. It includes banking locomotives

3.18
normal operating conditions
traffic operating to the design timetable and train formation used for power supply fixed installation design

Power supply equipment is operated according to standard design-rules

NOTE Standard rules may vary depending on the infrastructure manager's policy.

3.19
abnormal operating conditions
either higher traffic loads or outage of power supply equipment outside the design standard

NOTE Under these conditions, traffic may not operate to the design timetable.

3.20
mean useful voltage at the pantograph ($U_{\text{mean useful}}$)

3.20.1
$U_{\text{mean useful}}$ (zone)
voltage giving an indication of the quality of the power supply in a geographic zone during the peak traffic period in the timetable

3.20.2
$U_{\text{mean useful}}$ (train)
voltage identifying the dimensioning train and enables the effect on its performance to be quantified

3.21
dimensioning train
train with the lowest mean useful voltage

3.22
register of infrastructure
for TSI, a single document which compiles, for each section of line of the trans-European high speed rail or conventional network systems, the characteristics of the lines concerned for all subsystems that include fixed equipment.

This register of infrastructure should be drawn up by the infrastructure manager or its authorised representative.

For other lines, a single document which compiles, for each section of line, the characteristics of the lines concerned for all subsystems that include fixed equipment

3.23
infrastructure manager
any body or undertaking that is responsible in particular for establishing and maintaining railway infrastructure. This may also include the management of infrastructure control and safety systems. The functions of the infrastructure manager on a network or part of a network may be allocated to different bodies or undertakings

NOTE In TSI Energy, this body is referred to as the contracting or adjudicating entity.

3.24
new element
generally, any new, rebuilt or modified (hardware or software) traction-unit or power supply component having a possible influence on the harmonic behaviour of the power supply system.

This new element will be integrated in an existing power supply network with traction units e.g. for fixed installation side:

- transformer;
- HV cable;
- filters;
- converter

3.25
target network
network whose design allows the requirements of European interoperability and should avoid later costly investments

4 Periods over which parameters can be averaged or integrated

This clause is informative and refers to Annex A.

The train operators or infrastructure managers use parameters for

– their dimensioning computations,
– protection measures,
– planning;
– etc.

These are effective only if they are averaged over precisely defined time spans.

Annex A gives, for information, the periods over which those parameters should be averaged.

5 Neutral sections

5.1 AC phase separation sections

The train shall be able to move from one section to an adjacent one without bridging the two phases.

Power consumption of the train (traction, auxiliaries and no-load current of the transformer) shall be brought to zero when entering the phase separation section.

For HS TSI lines, this shall be done automatically.

For Conventional Rail TSI lines and for classical lines, automatic operation is preferred; however manual on board operation is also permitted.

Lowering of the pantographs is not necessary.

The infrastructure manager shall provide adequate means to allow a train that is gapped underneath the phase separation to be restarted.

NOTE For other designs of phase separation to be considered allowing the train to pass the section with power running e.g. automatically switched sections or "change over sections" if reliability and compatibility with all trains can be demonstrated, some requirements of this clause may not apply.

EN 50367 describes the design of phase separation sections.

5.2 System separation sections

5.2.1 General

The trains shall be able to move from one energy supply system to an adjacent one which uses a different energy supply without bridging the two contact line systems. The necessary actions (opening of the main circuit breaker, lowering of the pantographs) depend on the type of both supply systems as well as on the arrangement of pantographs on trains and the running speed.

There are two possibilities for the train to run through system separation sections:

1) with pantograph raised and touching the contact wire(s) as described in 5.2.2;
2) with pantograph lowered and not touching the contact wire(s) as described in 5.2.3.

The choice between 1) and 2) shall be made by the infrastructure manager.

The requirements for the design of the infrastructure and rolling stock are:

5.2.2 Pantograph raised

If the system separation sections are negotiated with pantographs raised to the contact wire(s), provisions shall be made in the infrastructure to avoid bridging the contact lines of both adjacent power supply systems when the opening of the on-board circuit breaker(s) fails.

– For categories I, II and III lines, on rolling stock, devices shall open automatically the circuit breaker before reaching the separation section and recognise automatically the voltage of the new power supply system at the pantograph in order to switch the corresponding circuits.

– For categories IV to VII lines and for classical lines, these requirements for categories I, II and III lines may be applied.

5.2.3 Pantograph lowered

If the system separation sections are negotiated with pantographs lowered the following conditions apply:

the design of separation section between differing energy supply systems shall ensure that, in case of a pantograph unintentionally applied to the contact line, bridging the contact lines of two power supply systems is avoided and switching off both supply sections is triggered immediately. If a system separation section is traversed with pantographs lowered, it shall be designed so as to avoid the bridging by an unintentionally raised pantograph. Equipment shall be provided to switch off both power supply systems should a pantograph remain raised, e.g. by detection of short circuits or unintended voltages.

– For categories I, II and III lines, at supply system separations which require a lowering of the pantograph, the pantograph shall be lowered without the driver's intervention, triggered by control signals.

– For categories IV to VII lines and for classical lines, these requirements for categories I, II and III lines may be applied.

EN 50367 describes the design of the system separation sections as well as some other functional requirements of the overhead-contact line and pantographs.

5.3 Acceptance criteria

Infrastructure, traction units and control command designers shall comply with the requirements of 5.1 and 5.2.

6 Power factor of a train

6.1 General

The higher the power factor of a train, the better is the power supply performance, therefore the rules below apply.

Capacitive or inductive power from a train can be utilised to change the overhead contact line voltage.

6.2 Inductive power factor

This clause deals only with inductive power factor and power consumption over the range of voltage from, U_{min1} to U_{max1} defined in EN 50163.

Table 1 gives the total inductive power factor λ of a train. For the calculation of λ, only the fundamental of the voltage at pantograph is taken into account.

Table 1 – Total inductive power factor λ of a train

	Category I and II of HS TSI lines [a]	TSI line category III; IV; V;VI; VII and Classical lines
MW		
$P > 2$	≥ 0,95	≥ 0,95
$0 \leq P \leq 2$	[b]	[b]

For yards or depot, the power factor of the fundamental wave shall be equal or higher to 0,8 (see the Note below) under the following conditions: the train is hotelling with traction power switched off and all auxiliaries running and the active power being drawn is greater than 200 kW.

The calculation of overall average λ for a train journey, including the stops, is taken from the active energy W_P (MWh) and reactive energy W_Q (MVArh) given by a computer simulation of a train journey or metered on an actual train:

$$\lambda = \sqrt{\frac{1}{1+\left(\frac{W_Q}{W_P}\right)^2}}$$

NOTE Higher power factors than 0,8 will result in better economic performance due to a reduced requirement for fixed equipment provision.

[a] Applicable to trains in conformity with the HS TSI "rolling stock".

[b] In order to control the total power factor of the auxiliary load of a train during the coasting phases, the overall average λ (traction and auxiliaries) defined by simulation and/or measurement shall be higher than 0,85 over a complete timetable journey (typical journey between two stations including commercial stops).

During regeneration, inductive power factor is allowed to decrease freely in order to keep voltage within limits.

NOTE 1 Another representation of Table 1 in a graphic form is given in Annex E.

NOTE 2 On line categories III to VII, for rolling stock existing before publication of this standard, the infrastructure manager may impose conditions e.g. economic, operating, power limitation for acceptance of interoperable trains having power factors below the value specified in Table 1.

6.3 Capacitive power factor

During traction mode and standstill, capacitive power factor is allowed in order to keep voltage within limits:

– within the range of voltage from U_{min1} to U_{max1} defined in EN 50163, capacitive power factors are not limited;

– within the range of voltage from U_{max1} to U_{max2} defined in EN 50163, a train shall not behave like a capacitor.

During regenerative mode, capacitive power factor is not allowed.

NOTE Capacitive power factors could lead to overvoltages and/or dynamic effects and should be treated according to Clause 10.

6.4 Acceptance criteria

The power factor is acceptable if the values given in Table 1 and requirement given in 6.3 are achieved.

7 Train current limitation

7.1 Maximum train current

The maximum allowable train current including auxiliary is given in Table 2. The levels apply both in tractive and regenerative modes. Higher or lower values of train current shall be given in the register of infrastructure (see 7.3) for each line when required.

NOTE In order to prevent the energy subsystem from over sizing, the values given in Table 2 are given for rolling stock and not for the design of the energy sub system for continuous load.