SLOVENSKI STANDARD
oSIST prEN 50617-2:2023

01-junij-2023

Železniške naprave - Tehnični parametri sistemov za ugotavljanje lokacije vlakov, ki zagotavljajo medobratovalnost vseevropskega železniškega sistema - 2. del: Števci osi

Railway applications - Technical parameters of train detection systems for the interoperability of the trans-European railway system - Part 2: Axle counters

Bahnanwendungen - Technische Parameter von Gleisfreimeldesystemen - Teil 2: Achszähler

Applications ferroviaires - Paramètres techniques des systèmes de détection des trains - Partie 2: Compteurs d'essieux

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45.020	Železniška tehnika na splošno	Railway engineering in general

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Railway applications - Technical parameters of train detection systems for the interoperability of the trans-European railway system - Part 2: Axle counters

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This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2023-08-18.

It has been drawn up by CLC/SC 9XA.

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 CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 50617-2:2023) has been prepared by CLC/SC 9XA “Communication, signalling and processing systems” of CLC/TC 9X “Electrical and electronic applications for railways”.

This document is currently submitted to the Enquiry.

The following dates are proposed:

• latest date by which the existence of this document has to be announced at national level	(doa)	dor + 6 months
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	dor + 12 months
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	dor + 36 months (to be confirmed or modified when voting)

This document will supersede EN 50617-2:2015 and all of its amendments and corrigenda (if any).

prEN 50617-2:2023 includes the following significant technical changes with respect to EN 50617-2:2015:

— Annex D: new informative annex for intermodulation effects potentially affecting the compatibility limits for Rolling Stock

This document is Part 2 of the EN 50617 series, which consists of the following parts under the common title “*Railway Applications - Technical parameters of train detection systems*”:

— Part 1: Track circuits;

— Part 2: Axle counters.

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

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

Introduction

The working group SC9XA WGA4-2 has developed the limits for electromagnetic compatibility between rolling stock and train detection systems, specifically track circuits and axle counter systems and correspondingly published two technical specifications CLC/TS 50238-2 and CLC/TS 50238-3. These limits and associated measurement methods are based on preferred existing systems (as defined in CLC/TS 50238-2 and CLC/TS 50238-3) which are well established and still put forward for signalling renewals by infrastructure managers.

To meet the requirements for compatibility between train detection systems and rolling stock in the future and to achieve interoperability and free movement within the European Union, ERA/ERTMS/033281 defines the relevant parameters for compatibility of rolling stock with track circuits and axle counter systems.

The train detection systems, track circuits and axle counters are an integral part of the CCS trackside subsystem in the context of the Rail Interoperability Directive. The relevant technical parameters are enumerated in the CCS and LOC&PAS TSI and ERA/ERTMS/033281. ERA/ERTMS/033281 specifies the parameters for rolling stock relevant to compatibility with the infrastructure. This document covers all relevant technical parameters of train detection systems (axle counter) in a manner that provides a presumption of conformity with interoperability requirements, but is not limited to interoperable lines. This document refers whenever needed to ERA/ERTMS/033281. Although the demand for FrM is driven by Interoperability requirements, it is independent from the drive to introduce systems like ERTMS level 3 or level 2.

This document is based on the current understanding of the railway experts represented at WGA4-2 that track circuits and axle counter systems will continue to be the essential two train detection systems for the foreseeable future.

The published specification CLC/TS 50238-3 can be used to ascertain conformity of rolling stock with existing individual wheel detectors.

In this document, the defined parameters are structured and allocated according to their basic references as follows:

— axle counter system parameters;

— train based parameters;

— track based parameters;

— environmental and other parameters.

Where possible, the parameters as defined are consistent with other European Standards.

Each parameter is defined by a short general description, the definition of the requirement, the relation to other standards and a procedure to show the fulfilment of the requirement as far as necessary. An overview of the safety relevance of each parameter is given – in the context of this document – in a separate table.

1 Scope

This document specifies parameters for the design and usage of axle counter systems.

For this, this document specifies the technical parameters of axle counter systems associated with the magnetic field limits for RST in the context of interoperability. In addition, test methods are defined for establishing the conformity and the performance of axle counter detector.

The specified parameters are structured and allocated according to their basic references as follows:

— axle counter system parameters;

— train based parameters;

— track based parameters;

— environmental and other parameters.

Each parameter is defined by a short general description, the definition of the requirement, the relation to other standards and a procedure to show the fulfilment of the requirement as far as necessary. An overview on the safety relevance of each parameter is given – in the context of this document – in a separate table.

This document is intended to be used to assess compliance of axle counter systems and other forms of wheel sensors used for train detection, in the context of the European Directive on the interoperability of the trans-European railway system and the associated technical specification for interoperability relating to the control-command and signalling track-side subsystems.

This document can also be used for axle counter systems installed on lines which are not declared as interoperable (including metro and tram lines).

For wheel sensors and wheel detectors in other applications than axle counters but utilizing the same sensors on the rail and detection circuits, transient and continuous interference can be considered as equivalent to axle counter detectors or axle counter sensors.

The frequency bands and rolling stock emission limits are currently defined in the axle counter FrM as specified in the ERA/ERTMS/033281 document.

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 16432-1:2017, *Railway applications - Ballastless track systems - Part 1: General requirements*

EN 50121-4:2017, *Railway applications - Electromagnetic compatibility - Part 4: Emission and immunity of the signalling and telecommunications apparatus*

EN 50124-2:2017, *Railway applications - Insulation coordination - Part 2: Overvoltages and related protection*

EN 50125-3:2003, *Railway applications - Environmental conditions for equipment - Part 3: Equipment for signalling and telecommunications*

EN 50126-1:2017, *Railway applications — The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) — Part 1: Generic RAMS Process*

EN 50126-2:2017, *Railway applications — The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) — Part 2: Systems Approach to Safety*

EN 50128:2011, *Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems*

EN 50129:2018, *Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling*

EN 50592:2016, *Railway applications - Testing of rolling stock for electromagnetic compatibility with axle counters*

EN 60068-2-1:2007, *Environmental testing - Part 2-1: Tests - Test A: Cold (IEC 60068-2-1)*

EN 60068-2-2:2007, *Environmental testing - Part 2-2: Tests - Test B: Dry heat (IEC 60068-2-2)*

EN 60068-2-30:2006, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30)*

EN 60529:1992, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

EN 61000-4-6:2014, *Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:2013)*

ERA/ERTMS/033281*, Interfaces between control-command and signalling trackside and other subsystems*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

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

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
antenna for generating magnetic fields
square loop antenna to generate the magnetic fields for testing of the immunity

3.1.2
axle counter detector
ACD
detector consisting of the axle counter sensor and of the detection circuit, which includes in general filters and rectifiers

3.1.3
axle counter sensor
sensor head mounted in the track

3.1.4
axle counter system
whole system including the axle counter detector with its sensor, and the evaluation unit

3.1.5
bandwidth
difference between the upper and lower frequencies in a contiguous set of frequencies and is typically measured in Hz

3.1.6
equipment under test
set of ACD connected to a rail

3.1.7
immunity level
maximum level of interfering signal at which the correct operation of the equipment is granted to be in line with expectations

3.1.8
in-band
in the working frequency area of an axle counter detector

3.1.9
inflection point
transition between the static (continuous wave) and dynamic immunity (short duration) behaviour of the ACD

3.1.10
integration time
window size over which the root mean square (RMS) of the output of the band-pass filter is calculated

3.1.11
measurement antenna
antenna mounted on the rail to capture magnetic field

Note 1 to entry: The measurement covers the axes X, Y and Z.

3.1.12
out-of-band
outside of the working frequency area of an ACD

3.1.13
right side failure
failure of a signalling system which results in a more restrictive condition for the movement of traffic than is appropriate

3.1.14
sinusoidal sway
maximum movement of a wheel in y-direction with the running of a train in relation to the inner flange of the rail head

3.1.15
working frequency range
frequency area or field where the sensors are operating

3.1.16
wrong side failure
failure of a signalling system which results in a less restrictive condition for the movement of traffic than is appropriate

3.2 Abbreviations

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

ACD	axle counter detector
AM	amplitude modulation
CCS	control-command and signalling
DC	direct current
EMC	electromagnetic compatibility

ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EUT	equipment under test
FFFIS	form fit functional interface specification
FGA	field generating antenna
FrM	frequency management
FSK	frequency shift key
HR	hazard rate
IP	International Protection
IR	Infrared (electromagnetic radiation)
IP(xx)	ingress protection (rating)
LC	inductor/capacitor resonant circuit
MA	measurement antenna
MIZ	metallic influencing zone
MTBF	mean time between failure
MTTR	mean time to repair
PS	power supply
RMS	root mean square
RSF	right side failure
RST	rolling stock
TEU	trackside electronic unit
THR	tolerable hazard rate
TSI	technical specification for interoperability
UV	Ultraviolet (electromagnetic radiation)
WSF	wrong side failure

4 Description of train detection system

Train detection systems for route proving as a fully automatic train detection system are integrated into railway signalling and safety systems. The train detection is part of the route proving procedure contributing to a safe and reliable railway operation.

The train detection equipment provides information about whether track sections are clear of or occupied by rail vehicles.

Axle counting systems operate on the principle of difference calculation. The evaluation unit evaluates the signals received from each counting head associated with a section, compares the number of axles which have entered the train detection section with the number of axles which have left this section and generates a “track clear” or “track occupied” indication.

Figure 1 defines the system boundaries of a train detection system using axle counter systems:

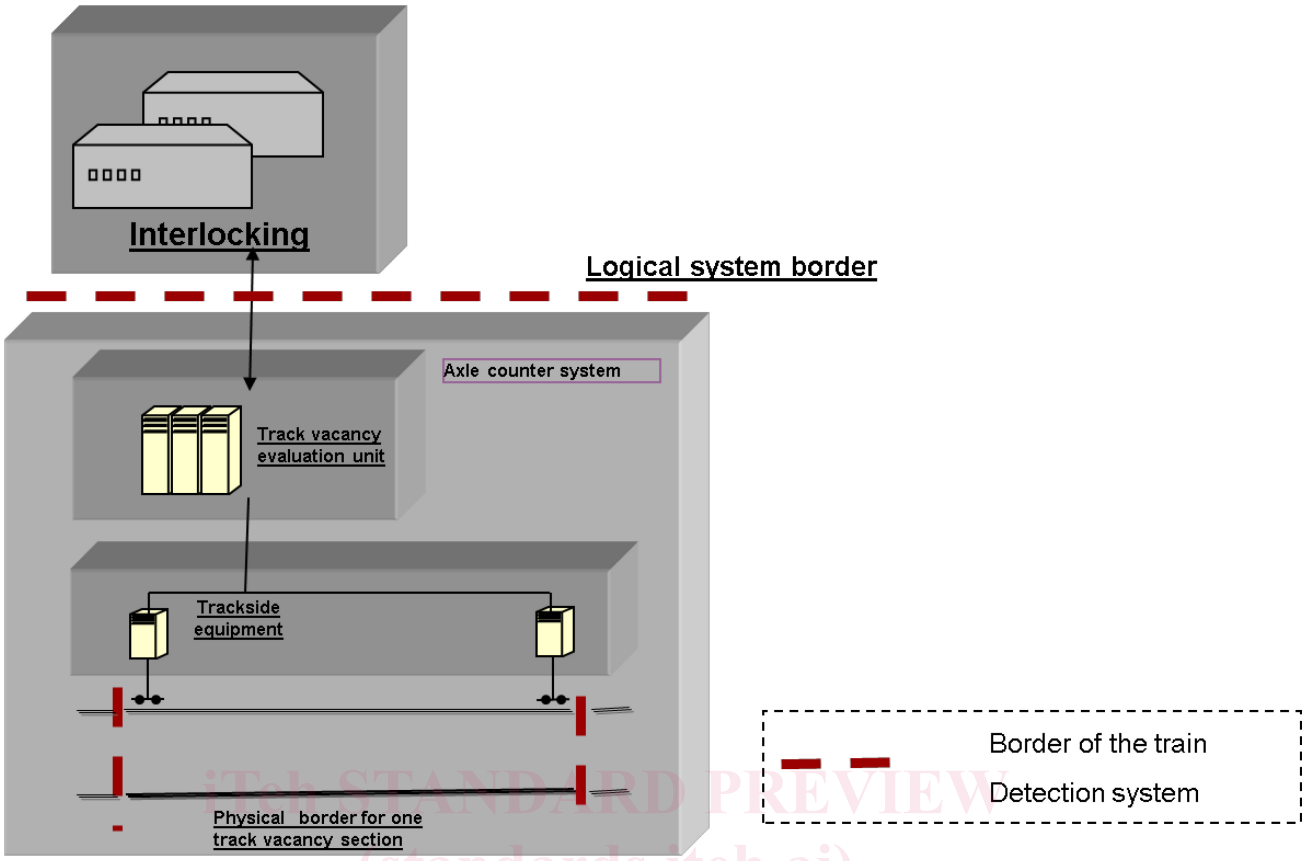

Figure 1 — System boundary of an axle counter system

5 Safety relevance per parameter

There are two degrees of safety relevance which may be assigned to the technical parameters of axle counter systems (see Table 1):

NOTE The issue safety relevance is defined in general in EN 50126-1:2017, EN 50126-2:2017 and EN 50129:2018 (see also 6.1.5). The information below is given only with respect to the parameters defined in this document.

— Direct safety relevant parameters:

  Failure to meet the direct safety relevant requirement can result directly in a wrong side failure.

— Indirect safety relevant parameters:

  Failure to meet the indirect safety relevant requirement may cause a right side failure but may also result in the occurrence of a second failure or human error which could subsequently lead to an accident, for example every not autocorrected fault count will lead to a reset of the section, which itself is a safety issue.

Indirect safety relevant parameters are generally availability related. A deviation may result in a reset being required. Human error may then lead to an accident.

The consequences of right side failures and errors shall therefore be evaluated in the context of risk analysis and appropriately mitigated in the equipment and system design, and in the operational rules.

Table 1 — Overview of safety relevance in the subclauses

Subclause	Direct safety relevance	Explanation
6.1.2 Availability	no	Part of the fail-safe behaviour of axle counter system
6.1.4 Maintainability	no	Not following the established maintenance regime can lead to RSF and potentially increase the risk of a WSF in certain cases.
6.1.5 Safety	yes	Safety criteria and safely level form determine the safety concept and design of the axle counter system.
6.2 Immunity against Magnetic fields – in-band and out-of-band	no	
C.4.5.3 Immunity to multiple transients	no	
6.1.5.2 Maximum time between trains	no	The parameter is safety related, as it influences the reliability. Exceedances do not lead directly to a hazard, however, the probability of WSF increases with time.
6.3 Immunity to traction and short circuit current in the rail	no	
6.4 Immunity to harmonics of traction current in the rail	no	
6.5 Sensor position integrity control (functional parameter)	yes	A sensor position integrity control is required to detect if an axle counter sensor has become detached from the rail and is not able to detect wheels.
6.6 Integration time	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
6.7 Signalling power supply quality with respect to availability	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
6.8 Requirements on the connection cables	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
7.2 Vehicle, wheel and speed dependent parameters	yes	Wheel dimensions which do not meet these requirements may lead to the wheel not being detected.
7.3 Material properties of vehicle parts in the detection area (metal free space)	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
7.4 Sinusoidal sway of train	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
7.5 Magnetic track brakes and eddy current brakes	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
8.1 Material of sleepers	no	Exceedances maycause a reliability problem which will be detected by the axle counter system.
8.2 Rail fittings/mounting area	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
8.3 Slab track	no	Exceedances may cause a reliability problem which will be detected by the axle counter system.
9 Environmental and other parameters	no	

6 Axle counter system parameters

6.1 RAMS

6.1.1 General

RAMS defined for the axle counter system which may control one or more sections. It can be assumed that one section consists of an average of about 1,3 axle counting detectors.

6.1.2 Reliability

Reliability is defined in EN 50126-1:2017, EN 50126-2:2017. A single reliability figure cannot be harmonized because it is a combination of qualitative and quantitative aspects.

6.1.3 Availability

The following information and definitions are derived from EN 50126-1:2017, EN 50126-2:2017.

The availability is one of the most significant parameters of an axle counter system. It is dependent on the sufficient immunity margin (compatibility margin between susceptibility threshold and the radiated emission level from RST). To ensure an adequate operational availability, a margin of 9 dB between the established immunity and the limit for rolling stock shall be applied. The value of 9 dB ensures a correct count.

NOTE Concerning the margin 9 dB see also 6.2.3.

For a standardized (typical) axle counter system section the following example of parameters may be used to determine an acceptable availability in terms of failures per train:

Axles per train: 25 (average)

Train movements per day per track: 100

$$\text{Availability} = 100\% \cdot \frac{\text{MTBF}}{(\text{MTBF} + \text{MTTR})}$$

Mean Time to repair (MTTR): 30 min (best case) – 300 min (worst case)

MTBF is calculated on the basis of component data and is for this reason product specific. The rate of miscounts is a separate parameter which may be affected by the geometry of wheels and other mechanical subsystems and EMC characteristics of rolling stock.

MTBF is a parameter of the equipment of the train detection system required for a single detection section. The integrity of the trackside cables and tracks/rails are excluded from the MTBF requirement calculations.

6.1.4 Rate of miscounts

The axle counter system shall fulfil the requirements derived by EN 50126-1:2017, EN 50126-2:2017.

The quality of service of an axle counter system shall be shown in the manufacturers document.

NOTE Quality of service means how often a manual activity of the operator is needed to reset a section.

6.1.5 Maintainability

The following information and definitions are derived from EN 50126-1:2017, EN 50126-2:2017 and EN 50129:2018.

The proper function of the axle counter system depends on correct installation, initial adjustment, preventive and corrective maintenance of the cabling, connections to the rail and position of the sensors.

The maintainability of the axle counter system shall be seen in the context of the complete integrated system including the ACD, the communication links, the evaluator unit and the power supplies.