PD CLC/TS 50238-3:2013

BSI Standards Publication

Railway applications — Compatibility between rolling stock and train detection systems

Part 3: Compatibility with axle counters

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National foreword

This Published Document is the UK implementation of CLC/TS 50238-3:2013. It supersedes DD CLC/TS 50238-3:2010, which will be withdrawn on 31 December 2016.

The UK participation in its preparation was entrusted by Technical Committee GEL/9, Railway Electrotechnical Applications, to Subcommittee GEL/9/1, Railway Electrotechnical Applications - Signalling and communications.

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Applications ferroviaires - Compatibilité entre le matériel roulant et les systèmes de détection des trains - Partie 3: Compatibilité avec les compteurs d'essieux

Bahnanwendungen - Kompatibilität zwischen Fahrzeugen und Gleisfreimeldesysteme - Teil 3: Kompatibilität mit Achszähler

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CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

This document (CLC/TS 50238-3:2013) has been prepared by CLC/SC 9XA "Communication, signalling and processing systems", of Technical Committee CLC/TC 9X "Electrical and electronic applications for railways".

This document supersedes CLC/TS 50238-3:2010.

CLC/TS 50238-3:2013 includes the following significant technical changes with respect to CLC/TS 50238-3:2010:

— this new edition represents a major technical change from the previous edition: the entire document has been changed, from the scope to the last clause, to take into account CLC/TC 9X decision 47-13 "*TC9X instructs WGA4-2 Convenor to remove sections about the procedure of testing of rolling stock from the draft TS 50238-3 (project 23571), considering SC9XA Decision 38/2*";

— Annexes B to D have been deleted.

This Technical Specification is Part 3 in the following series:

— EN 50238, *Railway applications – Compatibility between rolling stock and train detection systems*;

— CLC/TS 50238-2, *Railway applications – Compatibility between rolling stock and train detection systems – Part 2: Compatibility with track circuits*;

— CLC/TS 50238-3, *Railway applications – Compatibility between rolling stock and train detection systems – Part 3: Compatibility with axle counters*.

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Introduction

This Technical Specification defines the interference limits and evaluation criteria for electromagnetic compatibility between rolling stock and axle counter detectors.

The limits have been defined on the basis of a test specification described in prEN 50617-2:2013 [2] (cf. CLC/SC9XA/Sec0779/CD) (laboratory tests).

This Technical Specification defines

— a set of interference limits for magnetic fields resulting from both rail current and equipment on board the vehicles,

— evaluation criteria to verify rolling stock emissions and demonstrate compatibility with the interference limits for magnetic fields,

— traceability of requirements (type of axle counter detectors considered for the limits).

In the relevant frequency range of the axle counter detectors, the magnetic field is dominant and only this type of field is considered. Experience has shown that the effects of electric fields are insignificant and therefore not considered.

1 Scope

For the purpose of demonstrating compatibility between rolling stock and axle counter detectors, this Technical Specification defines the interference limits and evaluation methods to verify rolling stock emissions. Wheel sensors and crossing loops are not covered by this Technical Specification.

This Technical Specification gives recommended individual limits to be applied to establish compatibility between RST and all selected types of axle counter detectors, including any covered by national standards.

The list of selected types of axle counters and their limits for compatibility are drawn on the basis of established performance criteria. It is expected that the trend for newly signalled interoperable lines will be fitted with types that meet the compatibility limits published in the TSI CCS Interfaces Document (ERA/ERTMS/033281).

To ensure adequate operational availability, it is essential that the rolling stock complies with the defined limits; otherwise, the established availability of the valid output function of axle counter detectors may be compromised.

NOTE The influences from metal parts or inductively coupled resonant circuits on the vehicle, eddy current brakes or magnetic brakes, are not covered by this Technical Specification but are considered on the basis of national technical specifications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50238:2003, *Railway applications – Compatibility between rolling stock and train detection systems*

ERA/ERTMS/033281, *Interfaces between control-command and signalling trackside and other subsystems*, version 1.0, published on 2012-02-23

3 Terms, definitions and abbreviations

For the purposes of this document, the terms, definitions and abbreviations given in EN 50238:2003 and the following apply.

3.1 Terms and definitions

3.1.1
axle counter detector
detector consisting of the axle counter sensor and of the detection circuit, which includes in general filters and rectifiers

3.1.2
axle counter sensor
sensor head mounted in the track

3.1.3
axle counter system
whole system including axle counter sensor, axle counter detector and the evaluation unit

3.1.4
integration time
time constant of an axle counter detector indicating the range of time in which the immunity of the regarded axle counter detector to sinusoidal in band disturbances rises with shorter time duration of these disturbances (short term interference)

Note 1 to entry: Integration time is one parameter for evaluation of the measurement results of compatibility tests of vehicles (TSI CCS Interfaces Document ((ERA/ERTMS/033281)). It is defined as the window size over which the root mean square (rms) of the output of the band-pass filter is calculated.

3.1.5
in band
the whole frequency range (centre frequency plus or minus tolerance range) where a single axle counter works

Note 1 to entry: In relation with the frequency management of TSI CCS Interfaces Document (ERA/ERTMS/033281), it defines the area of the single bands (band 1, band 2, band 3).

3.2 Abbreviations

CCS Control-Command and Signalling

FM Frequency Management

rms root mean square

RST Rolling Stock

T_{int} Integration Time

TSI Technical Specification for Interoperability

4 General aspects

4.1 Interference mechanism

4.1.1 General

Axle counter detectors can be influenced in different ways, e.g. by magnetic fields or metallic parts in the vicinity of wheels and bogies and thus close to the sensors. The influence of magnetic fields in the range of the working frequency of the individual axle counters is dominant. In addition, the duration and/or repetition rate of interference and the magnetic field strength are also relevant.

4.1.2 Axle counter detector

The compatibility limits in this Technical Specification are based on the immunity of axle counter detectors and are specified only for the axle counter detector – comprising the sensor on the rail and the detection circuits in the trackside equipment as shown in Figure 1.

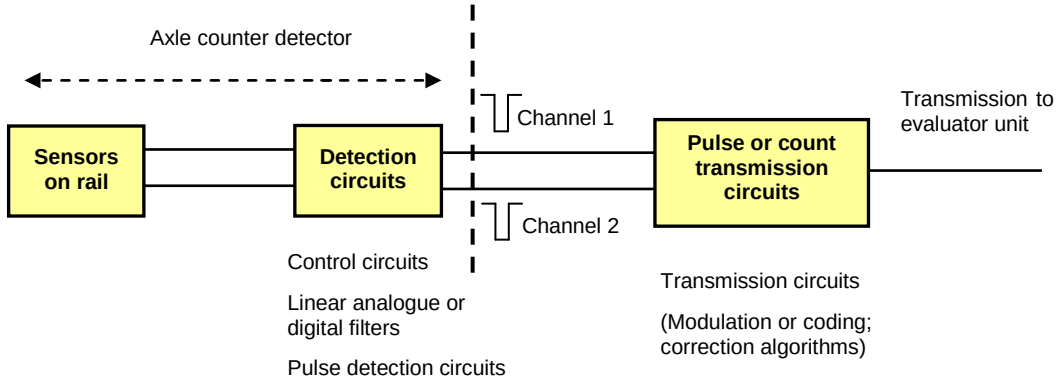

Figure 1 – Axle counter detector, schematic diagram

Axle counter detectors use various additional filter techniques and algorithms that reject interference pulses in order to maximise reliability while maintaining safety.

EXAMPLES

– non-linear pulse duration filters which reject wheel pulses of a duration less than the minimum wheel pulse from a vehicle;

– rejection of wheel pulses in one channel if the axle counter is already in an occupied status.

4.1.3 Susceptibility of the detector on the rail

The precise area of susceptibility is product specific, and defined by manufacturers of individual products. The position of the measurement antenna has been chosen to take into account the relevant sensors.

The immunity (susceptibility limit) is defined as the magnetic field that can generate interference pulses or corrupt the wheel pulses of one or more channels of the axle counter detector.

The magnetic coupling between the transmission and reception units of the axle counter sensor depends among other things on the rail type. Large rail profiles like UIC 60 profiles, which provide higher attenuation of the receiver voltage, are therefore more critical with respect to the susceptibility.

4.1.4 Sources of interference fields

The following sources of interference are considered for immunity:

— electrical equipment on the vehicle and magnetically coupled to the axle counter sensor through the air gap (hence referred to as magnetic fields);

— rail currents in the susceptibility range of operation of the axle counter sensor (hence referred to as rail current fields).

The interference fields from the two above defined sources are superimposed on the axle counter sensor whereby the vector of rail current fields has a predictable direction and the vector of magnetic fields has an unpredictable direction, because it is dependent on the source on the vehicle and on the type of rail.

4.2 Availability margin

Axle counter detectors are assumed to fail right side if excessive interference leads to a malfunction. A safety margin is therefore not required, but a margin is required to meet the performance requirements with regard to reliability of counting.

If the interference limit of the axle counter detector is exceeded and a resulting spurious wheel pulse is generated, this may or may not lead to a failure of the axle counter system.

A margin of 9 dB accounts for the following factors:

— 6 dB signal to noise ratio to meet the probability requirements for miscount within the established equipment operating tolerances;

— 3 dB accounting for

- uncertainty of measuring chain,
- positioning of the measurement antenna,
- overlapping effects (analysing methods),
- other environmental effects affecting interference (rain, temperature, etc.).

4.3 Specific axle counter parameters

The interference susceptibility of axle counter detectors depends, among other things, on the amplitude and the duration, for which the interference magnetic field is present. For continuous interference, the limits are lower than for short duration (transient) interference.

5 Compatibility requirements

5.1 RST emission limits based on the frequency management of the TSI CCS Interfaces Document (ERA/ERTMS/033281)

For future developments of rolling stock and axle counter detectors with the aim to decrease the development risk and to minimise the homologation effort for both rolling stock and axle counter detectors, a mandatory European frequency management is specified in the TSI CCS Interfaces Document (ERA/ERTMS/033281). The FM also defines out-of-band limits for compatibility with RST. The FM is based on the emission limits for existing axle counters published amongst others in Annex A. These limits have a margin above the actual immunity threshold, established in accordance with the immunity requirements specification defined in prEN 50617-2:2013 [2].

Evaluation for RST compatibility shall be done according to the parameters specified in the TSI CCS Interfaces Document (ERA/ERTMS/033281).

The corresponding measurement method and evaluation procedures are defined in prEN 50592 [1].

5.2 RST Emission limits for RST compatibility tests for individual axle counters on non-interoperable lines

5.2.1 General

For RST approval tests demonstrating compatibility with individual axle counters not covered by the FM, provided axle counter susceptibility is established according to the immunity specification defined in prEN 50617-2:2013 [2].

Evaluation for RST compatibility with individual axle counters shall be done according to the parameters specified in Annex A.

The corresponding measurement method and evaluation procedures are defined in prEN 50592 [1].

5.2.2 Short duration interference limits

In case the limits specified in Table A.1 are exceeded and the minimum time interval between two successive exceedances is bigger than the integration time defined, further evaluation for short duration interference shall be conducted for reduced integration times of e.g. 0,5 x T_{int} and 0,25 x T_{int}. For the axle counter detectors addressed in this Technical Specification, the emission limits and maximum time durations of exceedances for short-term interferences are listed in Table A.2.

A corresponding table is also defined in the frequency management of TSI CCS Interfaces Document (see Table 3 in ERA/ERTMS/033281, version 1.0, 2012-02-03).

Weighting of short duration interference is used in the following cases:

— short single discontinuous interference (transients):

- the duration of the disturbance shall be less than the product specific integration time and, in case of using higher emission limits, less than the reduced integration time;

— repetitive short duration interference:

- the repetition interval shall be greater than the integration time;
- the duration of the disturbance shall be less than the product specific integration time and, in case of using higher emission limits, less than the reduced integration time.

5.2.3 Mitigating arguments when limits are exceeded

Mitigating techniques may be used to achieve compatibility case for the vehicle in case where exceedances from the emission limits in Table A.1 are recorded. The compatibility case shall follow the requirements in EN 50238. From practical experience, a compatibility case is not credible if rolling stock emissions are 25 dB above the limits stated in Table A.1 under any condition.

With respect to interoperable rolling stock, the frequency management defined by the TSI CCS Interfaces Document (ERA/ERTMS/033281) over the complete frequency range shall be fulfilled.

Annex A
(normative)

Rolling stock emission limits

A.1 Emissions limits and evaluation parameters (narrow band)

Table A.1 defines the frequency ranges for existing types of axle counter detectors tested to the test specification identified in prEN 50617-2:2013 [2].

Table A.1 – Emission limits and evaluation parameters (narrow band)

Type of axle counter detector	Centre frequency, tolerance range kHz	Filter curve 3 dB / 20 dB bandwidth kHz	Filter [a] order using for evaluation	Magnetic field in X direction rms dBμA/m	Magnetic field in Y direction rms dBμA/m	Magnetic field in Z direction rms dBμA/m	Rail current [b] UIC 60 rms mA	Integration time T_{int} ms
Zp 30 H, Zp 30 C-NT, Zp30, Zp30K	27,0 - 32,0 [c]	± 0,12 / ± 0,45	4	114	94	101	220	4
D 39	39,0 ± 0,39	± 0,10 / ± 0,40	4	93	126	126	1 700	1
WDD39	39,0 ± 0,15	± 0,50 / ± 1,5	2	109,5	121,5	121,5	2 830	1
ZP 43 E	43,0 ± 1,0	± 0,16 / ± 1,2	4	100	83 to 90 [d]	98	68	1
ZP D 43, ZP D 43 I	43,0 ± 1,7	± 0,02 / ± 0,3	2	100	85	98	68	2
D 50	50,0 ± 0,50	± 0,10 / ± 0,40	4	93	126	126	1 700	1
WDD50	50,0 ± 0,15	± 0,50 / ± 1,5	4	109	121	121	2 470	1
WSD SYS 1	830,0 ± 26,0	± 4,0 / ± 15,0	4	106	85	101	80	1,5
WSD SYS 2	960,0 ± 26,0	± 4,0 / ± 15,0	4	106	85	101	80	1,5
RSR 180	250 ± 1,0	± 5,0 / ± 15	4	121	113,8	101,0	277,6	1,5
RSR 123 SYS 1	1 000,0 ± 1,0	± 3,0 / ± 10,0	4	120,5	114,5	114,5	1 750	2
RSR 123 SYS 2	1 228,8 ± 1,0	± 3,0 / ± 10,0	4	119,5	113,6	113,6	1 400	2
AS / ASZB 300	325,0 ± 25,0	± 2,0 / ± 13,0	4	111	101	87	100	8
ZK24-2 (ch-L)	166,9 ± 5,0	± 0,48 / ± 3,82	2	109	110	108	1 675	2,2
ZK24-2 (ch-H)	190,7 ± 5,0	± 0,42 / ± 3,55	2	108	110	108	1 426	2,2
ELS-93	42,01 ± 0,01 46,81 ± 0,01	± 1,5 / ± 3,2	4	92,3	85,6	110,2	231	2
ELS-95	46,81 ± 0,02 48,19 ± 0,02	± 1,0 / ± 2,6	4	93	99	98	133	2

a Filter type: Butterworth.
b Rail current only informative.
c Two frequencies in the range.
d Area between the first and the last axle of the vehicle under test (see Figure 7 in the TSI CCS Interfaces Document (ERA/ERTMS/033281, version 1.0, 2012-02-03))

A.2 Weighting of short duration interference

Table A.2 – Weighting of short duration interference (T_{int} according to Table A.1)

Type of axle counter detector	Increasing of magnetic field of Table A.1 / Maximum time interval of exceedances	Increasing of magnetic field of Table A.1 / Maximum time interval of exceedances
Zp 30 H Zp 30 C-NT	6 dB / 0,5 x T_{int}	12 dB / 0,25 x T_{int}
D 39	-	-
WDD39	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
ZP 43 E	6 dB / 0,5 x T_{int}	12 dB / 0,25 x T_{int}
ZP D 43	6 dB / 0,5 x T_{int}	12 dB / 0,25 x T_{int}
D 50	-	-
WDD50	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
WSD SYS 1	6 dB / 0,5 x T_{int}	12 dB / 0,25 x T_{int}
WSD SYS 2	6 dB / 0,5 x T_{int}	12 dB / 0,25 x T_{int}
RSR 180	6 dB / 0,5 x T_{int}	12 dB / 0,25 x T_{int}
RSR 123 SYS 1	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
RSR 123 SYS 2	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
AS / ASZB 300	3 dB / 0,5 x T_{int}	6 dB / 0,25 x T_{int}
ZK24-2 (ch-L)	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
ZK24-2 (ch-H)	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
ELS-93	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}
ELS-95	0 dB / 0,5 x T_{int}	0 dB / 0,25 x T_{int}

Bibliography

[1] prEN 50592 [1)], *Railway applications – Testing of rolling stock for compatibility with axle counters by measurement against defined limit values*

[2] prEN 50617-2:2013 [2)], *Railway applications – Basic parameters of train detection systems – Part 2: Axle counters*

[3] UIC 790, *Use of axle counters*

1) In preparation.

2) At enquiry stage. See also CLC/SC9XA/Sec0779/CD.

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