SLOVENSKI STANDARD
oSIST prEN 50121-3-1:2021

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Železniške naprave - Elektromagnetna združljivost - 3-1. del: Vozna sredstva - Vlak in celotno vozilo

Railway applications - Electromagnetic compatibility - Part 3-1: Rolling stock - Train and complete vehicle

Bahnanwendungen - Elektromagnetische Verträglichkeit - Teil 3-1: Bahnfahrzeuge – Zug und gesamtes Fahrzeug

Applications ferroviaires - Compatibilité électromagnétique - Partie 3-1: Matériel roulant – Trains et véhicules complets

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ICS:

33.100.01	Elektromagnetna združljivost na splošno	Electromagnetic compatibility in general
45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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EUROPEAN STANDARD

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Will supersede EN 50121-3-1:2017 and all of its amendments and corrigenda (if any)

English Version

Railway applications - Electromagnetic compatibility - Part 3-1: Rolling stock - Train and complete vehicle

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This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2021-10-15.

It has been drawn up by CLC/TC 9X.

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.

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.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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Contents

European foreword

This document (prEN 50121-3-1:2021) has been prepared by CLC/TC 9X “Electrical and electronic applications for railways”.

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 50121-3-1:2017 and all of its amendments and corrigenda (if any).

prEN 50121-3-1:2021 includes the following significant technical changes with respect to EN 50121-3-1:2017:

— Update of the scope (Clause 1), two paragraphs moved to Clause 4;

— update of the normative references (Clause 2);

— Update of applicability (Clause 4), two paragraphs from Clause 1 were introduced;

— Update of the European foreword.

— revision of Annex ZZ.

This European Standard is read in conjunction with EN 50121-1.

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.

This standard forms Part 3-1 of the EN 50121 series published under the general title “Railway applications - Electromagnetic compatibility”. The series consists of:

— Part 1: *General;*

— Part 2: *Emission of the whole railway system to the outside world;*

— Part 3-1: *Rolling stock - Train and complete vehicle;*

— Part 3-2: *Rolling stock – Apparatus;*

— Part 4: *Emission and immunity of the signalling and telecommunications apparatus;*

— Part 5: *Emission and immunity of fixed power supply installations and apparatus.*

Introduction

High power electronic equipment, together with low power microcontrollers and other electronic devices, are being installed on trains in great numbers. Electromagnetic compatibility has therefore become a critical issue for the design of train-related apparatus as well as of the train as a whole.

This document for rolling stock sets limits for electromagnetic emission and immunity in order to ensure a well functioning system within its intended environment.

Immunity limits are not given for the complete vehicle. EN 50121-3-2 defines requirements for the apparatus installed in the rolling stock, since it is impractical to test the complete unit. An EMC plan includes equipment covered by this document.

1 Scope

This document specifies the emission and immunity requirements for all types of rolling stock. It covers traction stock, hauled stock and trainsets including urban vehicles for use in city streets. This document specifies the emission limits of the rolling stock to the outside world.

The scope of this part of the standard ends at the interface of the rolling stock with its respective energy inputs and outputs. In the case of locomotives, trainsets, trams etc., this is the current collector (pantograph, shoe gear). In the case of hauled stock, this is the AC or DC auxiliary power connector. However, since the current collector is part of the traction stock, it is not entirely possible to exclude the effects of this interface with the power supply line. The slow moving test has been designed to minimize these effects.

There may be additional compatibility requirements within the railway system identified in the EMC plan (e.g. as specified in EN 50238).

Electromagnetic interference concerning the railway system as a whole is dealt with in EN 50121-2.

These specific provisions are to be used in conjunction with the general provisions in EN 50121-1.

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 50121-1:2017, *Railway applications - Electromagnetic compatibility - Part 1: General*

EN 50121-2:2017, *Railway applications - Electromagnetic compatibility - Part 2: Emission of the whole railway system to the outside world*

EN 50121-3-2:2020, *Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus*

EN IEC 55016-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus (CISPR 16-1-1:2019)*

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 terminological databases for use in standardization at the following addresses:

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

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

3.1.1
traction stock
electric and diesel locomotive, high speed trainset, elementary fixed combination of traction stock and hauled stock, electric and diesel multiple unit (no locomotive, distributed traction equipment), Light Railway Vehicle (LRV) such as tram, trolley bus or any other electrical vehicle for urban mass transit, underground trainset

3.1.2
hauled stock
independent passenger coaches and freight wagons (if they contain electric apparatus such as freezing equipment) which may be hauled in random combinations by different types of locomotives

3.1.3
main line vehicle
vehicle such as high speed train, suburban train, freight train, mainly designed to operate between cities

3.1.4
urban vehicle
vehicle such as underground trainset, tram, LRV (Light Rail Vehicle), trolleybus, mainly designed to operate within the boundary of a city

3.2 Abbreviations

AC	Alternating current
bw	Band width
DC	Direct current
E	Electric (field)
EMC	Electromagnetic compatibility
EUT	Equipment under test
H	Magnetic (field)
ISDN	Integrated Services Digital Network
ITU-T	International Telegraph Union – Telecommunication Standardization Sector
LRV	Light Rail Vehicle
PCM	Pulse – code modulation
QC	Quadrant converters
QP	Quasi-Peak
xDSL	all types of ***d**igital **s**ubscriber **l**ines*

4 Applicability

Generally, it is not possible to test electromagnetic compatibility invoking every function of the rolling stock. The tests shall be made at typical operating modes considered to produce the largest emission.

The typical operating mode shall require all systems to be energised which are normally in continuous operation during service. It is not necessary during the test to exercise systems which operate transiently such as for example operation of internal doors, although they should be energised. It is not necessary to test degraded modes of operation.

The configuration and mode of operation shall be specified in the test plan and the actual conditions during the tests shall be precisely noted in the test report.

Basically, all apparatus to be integrated into a vehicle meet the requirements of EN 50121-3-2. In exceptional cases, where apparatus meets another EMC Standard, but full compliance with EN 50121-3-2 is not demonstrated, EMC is ensured by adequate integration measures of the apparatus into the vehicle system and/or by an appropriate EMC analysis and test which justifies deviating from EN 50121-3-2.

The frequency range considered is from 0 Hz (DC) to 400 GHz. No measurements need to be performed at frequencies where no requirement is specified.

5 Immunity requirements

No tests are applied to the complete vehicle. It is expected that the assembly of the apparatus into a complete vehicle will give adequate immunity, provided that an EMC plan has been prepared and implemented, taking into account the requirements in EN 50121-3-2.

6 Emission tests and limits

6.1 General

The emission tests and limits for rolling stock in this standard should ensure as far as possible that the rolling stock does not interfere with typical installations in the vicinity of the railway system.

Measurements shall be performed in well-defined and reproducible conditions. It is not possible to totally separate the effects of the railway system and the stock under test. For radiated emissions, the test conditions are defined in 6.3.1 and 6.3.2.

NOTE 1 Signalling and communication, train radio and other railway systems (axle counters, track circuits, train control systems, etc.) are different in every country in terms of operating frequencies and waveforms. Therefore, compatibility requirements are specified according to the type of signalling and communication systems used (see e.g. EN 50238 series).

NOTE 2 There may be cases in which radio or other railway external services with working frequencies below 150 kHz are in operation close to the railway. The EMC management plan covers these cases and an adequate level of emission from the railway on these working frequencies may be found in the values given in informative Annex C hence no guarantee can be given for an undisturbed operation.

6.2 Interference on outside party telecommunication lines

6.2.1 Digital telecommunication lines

Interference with digital systems such as PCM, ISDN, xDSL are not covered in this European Standard.

It should be noted that these systems operate in a higher frequency range using multiple carriers and various automatic error correction protocols.

It is considered unlikely that rolling stock can produce sufficient interference in this frequency range.

6.2.2 Analogue telecommunication lines

No harmonized limits apply.

Information about interference on telecommunication lines can be found in Annex A.

6.3 Radiated electromagnetic disturbances

6.3.1 Test site

It can be assumed, that measurements will not take place in laboratory conditions. Trees, walls, bridges, tunnels or other conductive objects in the vicinity of the measurement antenna could have an impact on the measurement. Other railway vehicles operating in the same feeding section or nearby the measuring point may affect the measurement result. Overhead/third rail discontinuities as well as substations, power lines, buried lines, transformers, neutral sections, section insulators etc. close to the measuring point may cause additional variations.

These influences shall be reduced as far as practical but in any case no obstacles above rail level which may influence the measurements shall be located between antenna and EUT.

The overhead/third rail should be a continuous line as far as practical on both sides of the measurement point (typically at least 200 m).

Since it is impossible to avoid the support masts of the overhead, the measurement point shall be at the midpoint between masts, on the opposite side of the track (in case of a double track, on the side of the track which is being used). If the railway system is powered by a third rail, the antenna shall be on the same side of the track (worst case).

Since resonances may occur in the overhead line at radio-frequencies, it may be necessary to change the test site. The exact location of the test site and features of both the site and the overhead system layout shall be noted.

The contribution of the substation may be considered when assessing the emissions from the vehicle. Note that the contribution of a DC substation depends on its load current and will not be measured properly in a no-load condition.

At the beginning and at the end of the test series the ambient noise shall be recorded. This measurement shall be done without any influence of the vehicle.

If at specific frequencies or in specific frequency ranges the ambient noise is higher than the limit values less 6 dB, the measurements at these frequencies need not be considered. These frequencies shall be noted in the test report.

NOTE It may be helpful to perform this ambient noise measurement also with the vehicle completely powered down in front of the antenna.

6.3.2 Test conditions

The tests shall cover the operation of all systems onboard the rolling stock which may produce radiated emissions.

Hauled stock (a representative version) shall be tested while stationary in an energised mode (auxiliary converters, battery chargers, etc. in operation). The antenna should be sited opposite the equipment expected to produce the greatest emissions at the frequencies under measurement.

Tests for identical coaches or wagons are performed only once.

Traction stock shall be tested while stationary and at slow moving speed. During the stationary test, the auxiliary converters shall operate (it is not inevitably under maximum load conditions that the maximum emission level is produced) and the traction converters shall be under voltage but not operating. The antenna shall be in front of the middle of each vehicle unless an alternative location is expected to produce higher emission levels.

For the slow moving test, the speed shall be low enough to avoid arcing at or bouncing of the sliding contact and high enough to allow for electric braking. The recommended speed range is (20 ± 5) km/h for urban vehicles and (50 ± 10) km/h for main line vehicles. When passing the antenna, the vehicle

shall accelerate or decelerate with approximately 1/3 of its maximum tractive effort within the given speed range.

The slow moving test may be replaced by a stationary test with the vehicle operating at 1/3 of its maximum tractive effort against the mechanical brakes, if the following conditions are fulfilled:

— the traction equipment can be operated while the vehicle is stationary;

— tests of electric braking are not required, if no different circuits are used in braking.

If the slow moving test is replaced by a stationary test with tractive effort, then the slow moving limits shall be applied.

Any vehicles using onboard energy storage for traction shall use the test procedure and limits for slow moving test for the charging process.

NOTE Slow moving test procedure and limits are used for the charging process (for traction energy storing devices) because it has a short duration with high energy transfer.

6.3.3 Emission limits

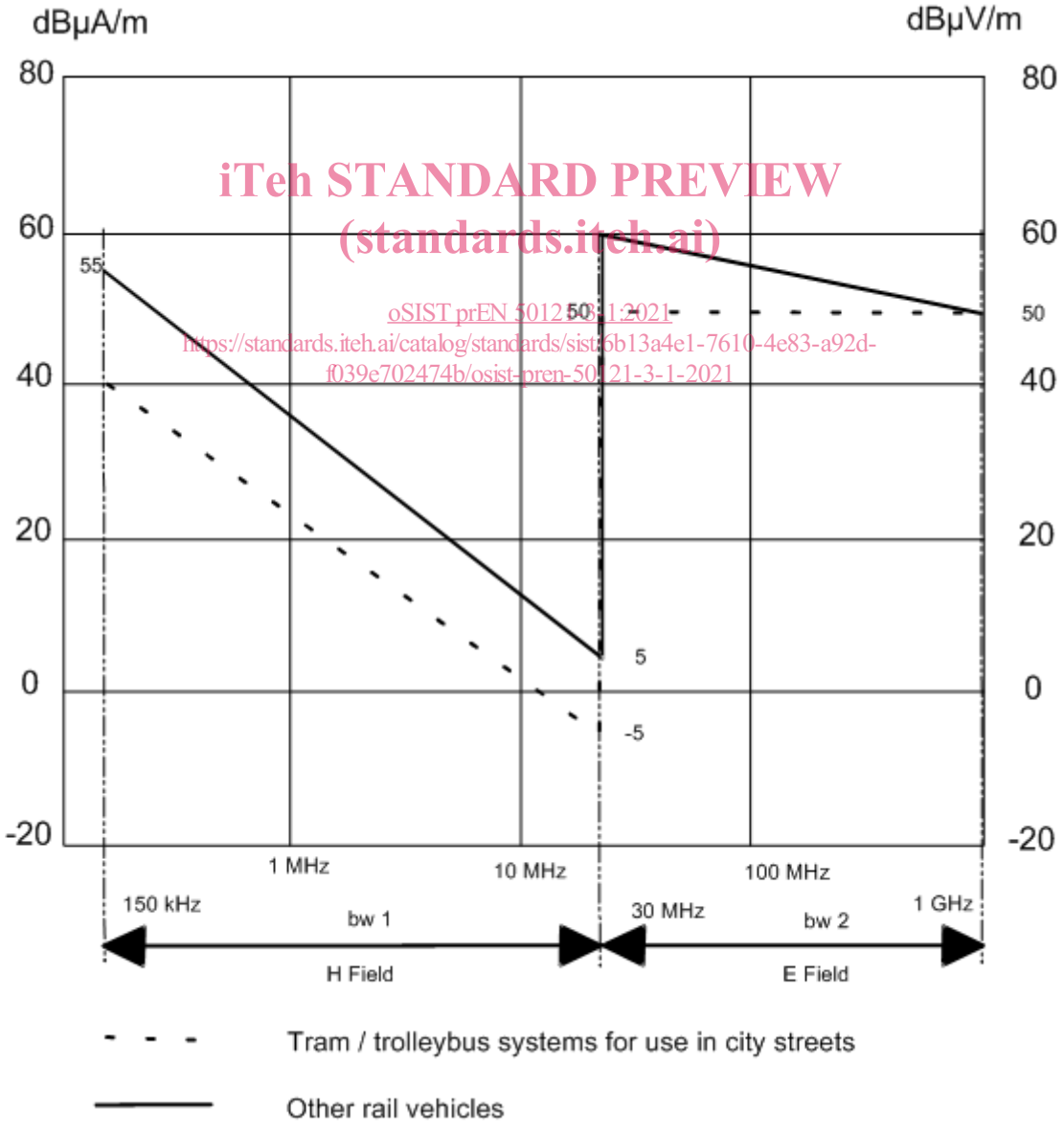

Figure 1 — Limits for stationary test (QP, 10 m)