



SLOVENSKI STANDARD

SIST EN 50121-3-1:2001

01-februar-2001

Nadomešča:

SIST ENV 50121-3-1:1998

**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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Ta slovenski standard je istoveten z: EN 50121-3-1:2000

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

EN 50121-3-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2000

ICS 29.020; 29.280; 45.060.01

English version

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

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

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

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This European Standard was approved by CENELEC on 2000-04-01. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Foreword

This European standard was prepared by SC 9XB, Electromechanical material on board of rolling stock, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways, in accordance with the decisions taken by TC 9X.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50121-3-1 on 2000-04-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-04-01

This European Standard is to be read in conjunction with EN 50121-1:2000.

This standard forms part 3-1 of the European Standard series EN 50121, 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

Annexes designated "normative" are part of the body of the standard
Annexes designated "informative" are given only for information.

In this standard, annex A is informative and annex B is normative.

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Introduction

High powered 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 Product Standard 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. Part 3-2 of this standard defines requirements for the apparatus installed in the rolling stock, since it is impractical to test the complete unit. An EMC plan shall be established for equipment covered by this standard.

1 Scope

This European Standard specifies the emission and immunity requirements for all types of rolling stock. It covers traction stock and trainsets including urban vehicles for use in city streets.

The frequency range considered is from d.c. to 400 GHz. At present, testing is not defined for frequencies above 1 GHz.

The scope of this part of the standard ends at the interface of the stock with its respective energy inputs and outputs. In the case of locomotives, trainsets, trams etc., this is the sliding contact (or the third rail), in case of hauled stock this is the a.c. or d.c. auxiliary power connector. However, since the pantograph is part of the tractive stock, it is not entirely possible to exclude the effects of this interface.

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

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These specific provisions are additional to the general provisions in EN 50121-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50121-1	Railway applications - Electromagnetic compatibility Part 1: General
EN 50121-2	Railway applications - Electromagnetic compatibility Part 2: Emission of the whole railway system to the outside world
EN 50121-3-2	Railway applications - Electromagnetic compatibility Part 3-2: Rolling stock - Apparatus
CISPR 16-1	Specification for radio disturbance and immunity measuring apparatus and methods -- Part 1: Radio disturbance and immunity measuring apparatus
ITU-T	Directive concerning the protection of telecommunication lines against harmful effects from electrical power and electrified railway lines Volume VI: Danger and disturbances

3 Definitions

For the purpose of this Part 3-1 of the European Standard, the following definitions apply:

3.1

stock

a complete railway product which is placed on the market as a single commercial unit

3.2

traction stock

electric and diesel locomotives, trainsets such as ICE and TGV, electric and diesel multiple units (no locomotive, each coach has its own traction equipment) for main line vehicles, Light Railway Vehicles (LRV) such as underground trainsets, trams, etc. for urban vehicles

3.3

hailed stock

all 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

3.4

main line vehicles

vehicles such as high speed trains, freight trains, mainly designed to operate between cities

3.5

urban vehicles

vehicles such as underground trainsets, trams, LRV, trolleybuses mainly designed to operate within the boundary of a city

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4 Applicability

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

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.

5 Immunity tests and limits

No tests are applied to the complete vehicle but the immunity tests and limits in Part 3-2 of this standard were selected in the knowledge that the vehicle should be immune to a level of 20 V/m over the frequency range 0,15 MHz to 1 GHz. 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, using the limits in Part 3-2 of this standard.

6 Emission tests and limits

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. Since it is not possible to totally separate the effects of the railway system and the stock under test, the operator and the manufacturer have to define for compatibility with signalling and communication systems and interference on telecommunication lines the test conditions (e.g. load conditions, speed and configuration of the units) and the test site in the contract. For radiated emissions, the test conditions are defined in 6.3.1 and 6.3.2. The contributions of other parts of the railway system (e.g. substations, signalling) and of the external environment (e.g. power lines, industrial sites, radio and television transmitters) to the measurements must be known and taken into account.

6.1 Compatibility with signalling and communication systems

Signalling, 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, emission requirements shall be specified according to the type of signalling and communication systems used (see annex B of EN 50121-1).

The requirements need to take into account sources of disturbance other than the rolling stock, including the train radio and signalling systems themselves, and the effects of transients due to bad contact, pantograph bouncing, third rail gaps, etc.

6.2 Interference on telecommunication lines

6.2.1 Digital telecommunication lines

Interference with digital systems such as PCM, ISDN,... is not covered in this standard.

6.2.2 Analogue telecommunication lines

The harmonics in the traction current of a railway system may induce noise in a conventional analogue telecommunication system. The acceptable level of noise on conventional analogue telephone lines is specified by ITU-T. The value of this noise is measured with a psophometric filter. The relationship between the current absorbed or generated by the traction vehicle and the noise in the telephone line is neither under the total control of the vehicle manufacturer nor of the operator of the network (For details see A.1). Thus it shall be the responsibility of the purchaser of the tractive stock in accordance with the rules of the Infrastructure Controllers to specify a frequency weighted current limit at the vehicle interface.

One method commonly used is to specify the psophometric current I_{pso} which has a psophometrical frequency weighting. The background and application of this method is described in annex A. As it is known that the I_{pso} method does not fully represent the noise effect of the harmonics in the kHz range, alternative methods of frequency weighting may be specified by the purchaser.

6.3 Radiated electromagnetic disturbances

6.3.1 Test site

The test site shall meet as far as possible the „free space“ requirements below within the existing constraints of the railway environment;

- No trees, walls, bridges, tunnels or vehicles shall be close to the measurement point, minimum separation distance:

30 m	for main line vehicles
10 m	for urban vehicles
- 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).
- The overhead/third rail should be an „infinite“ line on both sides of the measurement point, the minimum clear length on both sides of the measurement point should be:

3 km	for main line vehicles
500 m	for urban vehicles

Overhead/third rail discontinuities as well as substations, transformers, neutral sections, section insulators etc. should be avoided.

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

The contribution of the substation shall be known or measured before measuring the noise of the vehicle.

- Close proximity to power lines including buried lines, substations, etc. should be avoided.
- No other railway vehicle should be operating within a distance of:

20 km for main line vehicles
2 km for urban vehicles

If these conditions are not possible, the ambient noise before and after each emission measurement of the vehicle under test shall be recorded. Otherwise only two ambient noise measurements at the beginning and the end of the test series are sufficient.

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

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 shall be tested while stationary in an energised mode (auxiliary converters, battery chargers, etc. in operation).

Tractive stock shall be tested whilst 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.

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 allows for operation whilst 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. The decision for the stationary test with tractive effort has to be justified in the test report.