

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**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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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
ELECTROMAGNETIC COMPATIBILITY –****Part 3-1: Rolling stock –
Train and complete vehicle**

FOREWORD

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International Standard IEC 62236-3-1 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This second edition cancels and replaces the first edition published in 2003. It constitutes a technical revision and is based on EN 50121-3-1:2006.

The main change with respect to the previous edition is listed below:

- incorporation of emission limits for urban vehicles operating in city streets.

The text of this standard is based on the following documents:

FDIS	Report on voting
9/1186/FDIS	9/1214/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62236 series, published under the general title *Railway applications – Electromagnetic compatibility*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

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 should be established for equipment covered by this part of IEC 62236.

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RAILWAY APPLICATIONS – ELECTROMAGNETIC COMPATIBILITY –

Part 3-1: Rolling stock – Train and complete vehicle

1 Scope

This part of IEC 62236 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. No measurements need to be performed at frequencies where no requirement is specified.

The scope of this 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 a.c. or d.c. 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 minimise these effects.

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

The electromagnetic interference concerning the railway system as a whole is dealt with in IEC 62236-2.

These specific provisions are to be used in conjunction with the general provisions in IEC 62236-1.

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.

IEC 62236-1, *Railway applications – Electromagnetic compatibility – Part 1: General*

IEC 62236-2, *Railway applications – Electromagnetic compatibility – Part 2: Emission of the whole railway system to the outside world*

IEC 62236-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62427, *Railway applications – Compatibility between rolling stock and train detection systems*

CISPR 16-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – 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 Terms and definitions

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

3.1

traction stock

electric and diesel locomotives, high speed trainsets, 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

3.2

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

3.3

main line vehicles

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

3.4

urban vehicles

vehicles such as underground trainsets, trams, LRV (Light Rail Vehicles), trolleybuses, mainly designed to operate within the boundary of a city

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 can be deemed to be immune to a level of 20 V/m over the frequency range 0,15 MHz to 2 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, taking into account 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. It is not possible to totally separate the effects of the railway system and the stock under test. Therefore, the operator and the manufacturer have to define in the contract the test conditions and the test site for compatibility with signalling and communication systems and for interference on telecommunication lines, (e.g. load conditions, speed and configuration of the units). 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 IEC 62427).

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 Clause 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_{ps0} 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_{ps0} 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, 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 d.c. substation depends on its load current and will not be measured properly in a no-load condition;

- close proximity to power lines including buried lines, substations, etc., should be avoided;
- no other railway vehicle should be operating in the same feeding section or 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 values 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). The antenna should be sited opposite the equipment expected to produce the greatest emissions at the frequencies under measurement.

Traction 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. The antenna should be sited opposite the vehicle centre line 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.

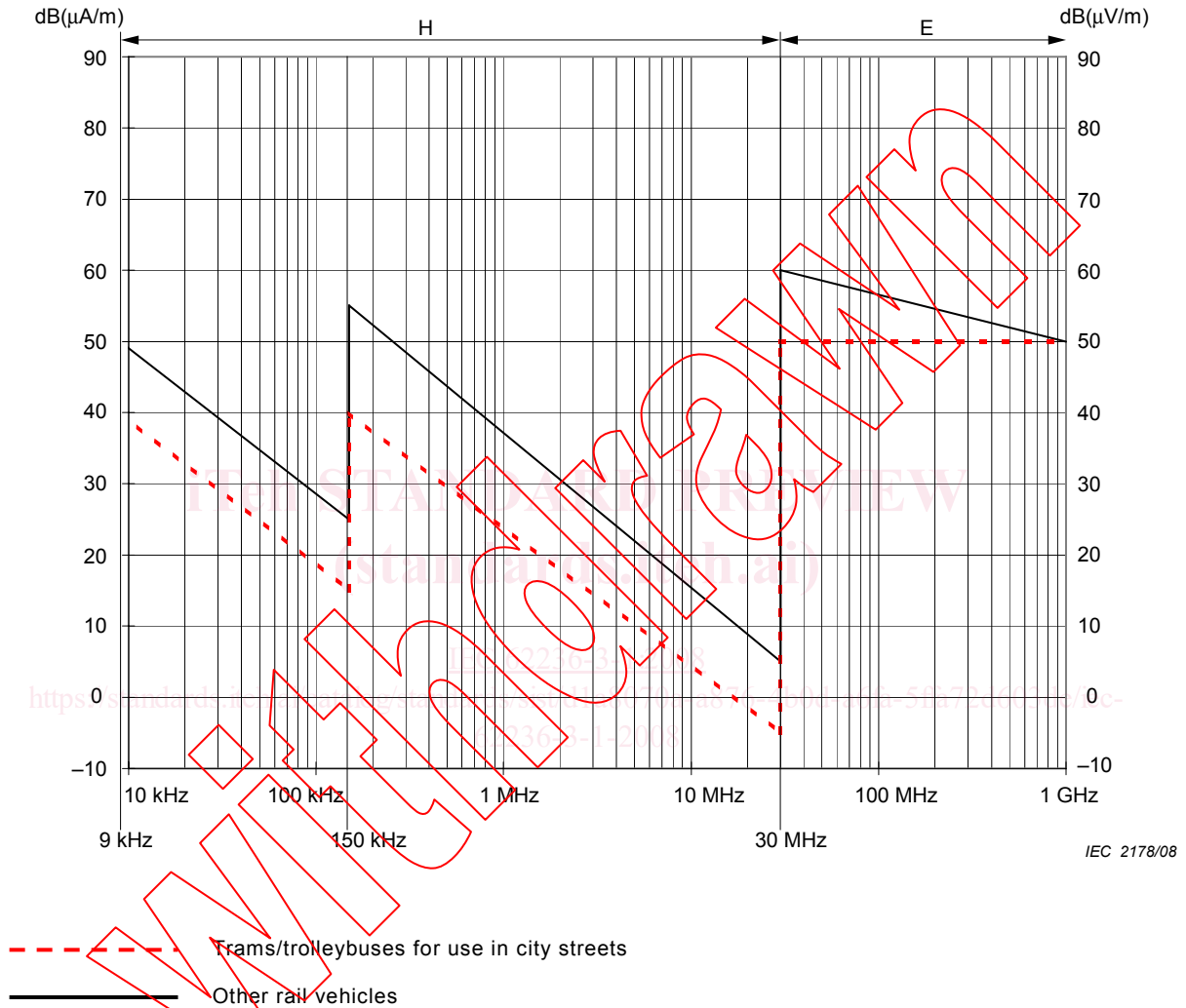
The slow moving test may be replaced by a stationary test with the vehicle operating at 1/3 of its maximum tractive effort against the mechanical brakes, if the following conditions are fulfilled:

- the traction equipment 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.

6.3.3 Emission limits



NOTE 1 The limits are defined as quasi-peak values and the bandwidths are those used in CISPR 16-1-1:

	Bandwidth
Frequencies up to 150 kHz	200 Hz
Frequencies from 150 kHz to 30 MHz	9 kHz
Frequencies above 30 MHz	120 kHz

NOTE 2 All values are measured at a distance of 10 m.

Figure 1 – Limits for stationary test (quasi-peak, 10 m)