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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus

Applications ferroviaires – Compatibilité électromagnétique – Partie 3-2: Matériel roulant – Appareils

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FOREWORD

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International Standard IEC 62236-3-2 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 50121-3-2:2006.

The main changes with respect to the previous edition are listed below:

– requirements for the surge immunity test of line 7.2 in Table 7;
– requirements for the radiated immunity test of line 9.2 in Table 9.

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

FDIS	Report on voting
9/1187/FDIS	9/1215/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- withdrawn,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
- amended.

RAILWAY APPLICATIONS – ELECTROMAGNETIC COMPATIBILITY –

Part 3-2: Rolling stock – Apparatus

1 Scope

This part of IEC 62236 applies to emission and immunity aspects of EMC for electrical and electronic apparatus intended for use on railway rolling stock. IEC 62236-3-2 applies for the integration of apparatus on rolling stock.

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 application of tests shall depend on the particular apparatus, its configuration, its ports, its technology and its operating conditions.

This standard takes into account the internal environment of the railway rolling stock and the external environment of the railway, and interference to the apparatus from equipment such as hand-held radio transmitters.

If a port is intended to transmit or receive for the purpose of radio communication (intentional radiators, e.g. transponder systems), then the emission and immunity limits in this standard at the communication frequency do not apply.

This standard does not apply to transient emissions when starting or stopping the apparatus.

The objective of this standard is to define limits and test methods for electromagnetic emissions and immunity test requirements in relation to conducted and radiated disturbances.

Emission requirements have been selected so as to ensure that disturbances generated by the apparatus operated normally on railway rolling stock do not exceed a level which could prevent other apparatus from operating as intended.

Likewise, the immunity requirements have been selected so as to ensure an adequate level of immunity for rolling stock apparatus.

The levels do not however cover extreme cases which may occur with an extremely low probability of occurrence in any location. Specific requirements which deviate from this standard shall be specified.

Test requirements are specified for each port considered.

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 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

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

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

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

IEC 62236-3-1, *Railway applications – Electromagnetic compatibility – Part 3-1: Rolling stock – Train and complete vehicle*

CISPR 11, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 16 (all parts), *Specification for radio disturbance and immunity measuring apparatus and methods*

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

3 Terms and definitions

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

3.1
rolling stock apparatus
finished product with an intrinsic function intended for implementation into the rolling stock installation

3.2
port
the particular interface of the specified apparatus with the external environment, for example a.c. power port, d.c. power port, I/O (input/output) port

3.3
enclosure port
the physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

The main categories of ports for rolling stock apparatus are presented in Figure 1.

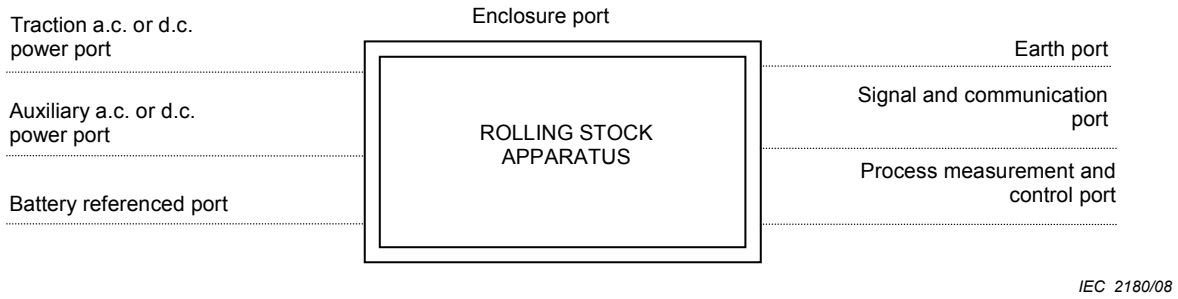

Figure 1 – Main categories of ports

Typical examples of rolling stock apparatus with their ports are listed in Annex A.

4 Performance criteria

The variety and the diversity of the apparatus within the scope of this standard make it difficult to define precise criteria for the evaluation of the immunity test results.

A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report, based on the criteria A, B, C defined in IEC 62236-1.

5 Conditions during testing

It is not always possible to test every function of the apparatus. The tests shall be made at a typical operating mode considered by the manufacturer to produce the largest emission or maximum susceptibility to noise as appropriate in the frequency band being investigated consistent with normal applications. The manufacturer shall define the conditions during testing in a test plan.

If the apparatus is part of a system, or can be connected to auxiliary apparatus, then the apparatus shall be tested while connected to the minimum configuration of auxiliary apparatus necessary to exercise the ports in accordance with CISPR 22.

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.

If the apparatus has a large number of similar ports or ports with many similar connections, then a sufficient number shall be selected to simulate actual operating conditions and to ensure that all the different types of termination are covered (e.g. 20 % of the ports or at least four ports).

The tests shall be carried out within the specified operating range for the apparatus and at its rated supply voltage, unless otherwise indicated in the basic standard.

6 Applicability

The measurements in this standard shall be made on the relevant ports of the apparatus.

It may be determined from consideration of the electrical characteristics, the connection and the usage of a particular apparatus that some of the tests are not applicable (e.g. radiated immunity of induction motors, transformers). In such cases, the decision not to test has to be recorded in the test plan or test report.

If not otherwise specified, the EMC tests shall be type tests.

7 Emission tests and limits

The emission tests and limits for apparatus covered by this standard are given on a port by port basis.

Measurements shall be performed in well-defined and reproducible conditions for each type of disturbance.

The description of the test, the test methods and the test set-up are given in Basic Standards which are referred to in Tables 1 to 6.

The contents of these basic standards are not repeated here, however modifications or additional information needed for the practical application of the tests are given in this standard.

NOTE The reference to “basic standard“ is intended to be limited to those parts of the standard that give the description of the test, the test methods and the test set-up.

Table 1 – Emission – Traction a.c. power ports

	Port	Test specification		Basic standard	Test set-up	Remarks
1.1	**High voltage connection, input side before filter** (port 3 on Figures A.1, A.2 and A.3)	Signalling and telecommunication frequencies	see IEC 62236-3-1			
		9 kHz - 30 MHz	No limits			See Notes 1 and 2
NOTE 1 No conducted radio frequency limits are applied. The apparatus when installed with other surrounding equipment should satisfy the radiated emission limits of IEC 62236-3-1 for trains. NOTE 2 It is desirable but not possible to apply conducted radio frequency limits. No practical test method exists and the relationship between conducted emissions and radiated emissions is not possible to define.						

Table 2 – Emission – Traction d.c. power ports

	Port	Test specification		Basic standard	Test set-up	Remarks
2.1	**High voltage connection, input side before filter** (port 3 on Figure A.4)	Signalling and telecommunication frequencies	see IEC 62236-3-1			
		9 kHz - 30 MHz	No limits			See Notes 1 and 2
NOTE 1 No conducted radio frequency limits are applied. The apparatus when installed with other surrounding equipment should satisfy the radiated emission limits of IEC 62236-3-1 for trains. NOTE 2 At present, there is no agreed method or limit for conducted emissions on the traction supply from 9 kHz to 30 MHz. Limiting conducted emissions from an apparatus connected to the traction supply will prevent excessive radiated emissions from the supply system. A method for measuring conducted emissions is proposed in Annex B. Experience in this technique and the relationship between conducted and radiated emissions are necessary in order to make this standard progress in the future.						

Table 3 – Emission – Auxiliary a.c. or d.c. power ports

	Port	Test specification		Basic standard	Test set-up	Remarks
3.1	**Auxiliary supply sinusoidal a.c. or d.c.** (port 9 on Figures A.1, A.2 and A.4)	9 kHz - 150 kHz	No limits	CISPR 11	CISPR 11	See Notes 1 and 2
		150 kHz - 500 kHz	99 dBµV quasi-peak			See Notes 3, 4 and 5
		500 kHz - 30 MHz	93 dBµV quasi-peak			See Notes 3, 4 and 5

NOTE 1 At present, there are no limits for conducted emissions from 9 kHz to 150 kHz. Limiting conducted emissions from an apparatus will prevent excessive radiated emissions. Experience in this technique and the relationship between conducted and radiated emissions are necessary in order to make this standard progress in the future.

NOTE 2 230 V AC power outlet ports for public use should offer a power quality, which is sufficient for the use of intended equipment like PC and mobile telephone chargers. The total harmonic distortion should be limited by a sine-filter to ≤ 8 %. The burst and surge emissions of the outlet should be limited to the levels of residential equipment according to IEC 61000-6-1. AM radio receivers are not intended to be supplied by these power outlets.

NOTE 3 Wherever applicable the method defined by CISPR 11 is to be used. At present, the existing method of measuring conducted emissions (CISPR 11) has limitations in terms of voltage and current rating of coupling networks. In addition, the method of measuring voltage has safety implications for testing high power systems. Limiting conducted emissions from apparatus connected to external cable systems will prevent excessive radiated emissions.

NOTE 4 This requirement refers to the industrial limit values but considering they have been defined to protect radio and TV sets and as the objective is not the same here, the applicable limit for railway applications has been relaxed by 20 dB to be more representative of potential problems.

NOTE 5 This requirement is not applicable to power ports which are connected to other dedicated, compatible ports.

Table 4 – Emission – Battery referenced ports

	Port	Test specification		Basic standard	Test set-up	Remarks
4.1	**Battery power supply** (port 10 on Figures A.1 to A.5)	9 kHz - 150 kHz	No limits	CISPR 11	CISPR 11	See Note 1
		150 kHz - 500 kHz	99 dBµV quasi-peak			See Note 2
		500 kHz - 30 MHz	93 dBµV quasi-peak			See Note 2

NOTE 1 At present, there are no limits for conducted emissions from 9 kHz to 150 kHz. Limiting conducted emissions from an apparatus will prevent excessive radiated emissions. Experience in this technique and the relationship between conducted and radiated emissions is necessary in order to make this standard progress in the future.

NOTE 2 This requirement refers to the industrial limit values but considering they have been defined to protect radio and TV sets and as the objective is not the same here, the applicable limit for railway applications has been relaxed by 20 dB to be more representative of potential problems.

Table 5 – Emission – Process measurement and control ports

	Port	Test specification		Basic standard	Test set-up	Remarks
5.1	**Electronic supply sinusoidal a.c. or d.c.** (port 16 on Figure A.5)	9 kHz - 150 kHz	No limits	CISPR 11	CISPR 11	See Note 1
		150 kHz - 500 kHz	99 dBµV quasi-peak			See Note 2
		500 kHz - 30 MHz	93 dBµV quasi-peak			See Note 2
NOTE 1 At present, there are no limits for conducted emissions from 9 kHz to 150 kHz. Limiting conducted emissions from an apparatus will prevent excessive radiated emissions. Experience in this technique and the relationship between conducted and radiated emissions is necessary in order to make this standard progress in the future. NOTE 2 This requirement refers to the industrial limit values but considering they have been defined to protect radio and TV sets and as the objective is not the same here, the applicable limit for railway applications has been relaxed by 20 dB to be more representative of potential problems.						

Table 6 – Emission – Enclosure port

	Port	Test specification		Basic standard	Test set-up	Remarks
6.1	**Enclosure**	30 MHz - 230 MHz	40 dBµV/m quasi-peak	CISPR 11	CISPR 11	See Notes 1 and 2
		230 MHz - 1 GHz	47 dBµV/m quasi-peak			See Notes 1 and 2
NOTE 1 The measurement distance is 10 m. A measurement distance of 3 m may be used with the limit increased by 10 dB. NOTE 2 Traction converters and auxiliary converters over 50 kVA need not be tested individually but when the vehicle is tested as a whole in accordance with IEC 62236-3-1.						

8 Immunity tests and limits

The immunity tests and limits for apparatus covered by this standard are given on a port by port basis.

To ensure the immunity of the complete vehicle, the limits shall be applicable to all relevant apparatus.

Tests shall be conducted in a well-defined and reproducible manner.

The tests shall be carried out as single tests in sequence. The sequence of testing is optional.

The description of the test, the test generator, the test methods and the test set-up are given in basic standards which are referred to in Tables 7 to 9.

The contents of these “basic standards“ are not repeated here, however modifications or additional information needed for the practical application of the tests are given in this standard.

Table 7 – Immunity – Battery referenced ports (except at the output of energy sources), auxiliary a.c. power input ports (rated voltage ≤ 400 $V_{r.m.s.}$)

	Environmental phenomena	Test specification		Basic standard	Test set-up	Remarks	Performance criteria
7.1	**Radio-frequency common mode**	0,15 MHz - 80 MHz 10 V (r.m.s.) 80 % AM, 1 kHz	Unmodulated carrier	IEC 61000-4-6	IEC 61000-4-6	See Note 1 The test level specified is the r.m.s. value of the unmodulated carrier	**A**
7.2	**Fast transients**	± 2 kV 5/50 ns 5 kHz	Peak T_r / T_h Repetition frequency	IEC 61000-4-4	IEC 61000-4-4	See Note 2	**A**
7.3	**Surges**	1,2 / 50 µs ± 2 kV 42 Ω, 0,5 µF ± 1 kV 42 Ω, 0,5 µF	Open circuit test voltage, line to ground Open circuit test voltage, line to line	IEC 61000-4-5	IEC 61000-4-5	See Note 3	**B**

NOTE 1 The test level can also be defined as the equivalent current into a 150 Ω load.

NOTE 2 Direct coupling, positive and negative polarity.

NOTE 3 This test is intended to replicate the phenomenon known as direct coupling; hence an output impedance of 42 Ω (40 Ω and 2 Ω generator) and a coupling capacitance of 0,5 µF is recommended.