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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Electromagnetic compatibility – Part 1: General

Applications ferroviaires – Compatibilité électromagnétique – Partie 1: Généralités

IEC 62236-1:2008

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Part 1: General

FOREWORD

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International Standard IEC 62236-1 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 50121-1:2006.

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

– rewording of the introduction;
– suppression of Annex B.

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

FDIS	Report on voting
9/1184/FDIS	9/1212/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- withdrawn,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.

INTRODUCTION

The railway EMC set of product-specific International Standards consists of five parts described at the end of this introduction.

The set of standards provides both a framework for managing the EMC for railways and also specifies the limits for the electromagnetic (EM) emission of the railway as a whole to the outside world and for the EM emission and immunity for equipment operating within the railway. The latter must be compatible with the emission limits set for the railway as a whole and also provides for establishing confidence in equipment being Fit For Purpose in the Railway environment. There are different stationary emission limits set for trams/trolleybuses and for metro/mainline railways. The frequency covered by the standards is in the range from d.c. to 400 GHz. No measurements need to be performed at frequencies where no requirement is specified. The limits for EMC phenomena are set so that the railway as a whole achieves electromagnetic compatibility with the outside world, and between the various parts of the railway. Throughout the set of standards, the immunity levels are chosen to ensure a reasonable level of EMC with other apparatus within the local railway environment and with emissions which enter the railway from the outside world. Limits are also placed on EM emission by railways into the outside world.

The compatibility between railway emissions and their external environment is based upon emission limits from the railways being set by considering results from measurements. Given that the general compatibility between railways and their environment was satisfactory at the time these measurements were made and subsequent experience of applying the limits has confirmed their acceptability, compliance with this part of IEC 62236 has been judged to give satisfactory compatibility. The immunity and emission levels do not of themselves guarantee that the railway will have satisfactory compliance with its neighbours. In exceptional circumstances, for instance near a “special location” which has unusually high levels of EM interference, the railway system may require additional measures to be taken to ensure proper compatibility. Particular care should be taken when in proximity to equipment such as radio transmission equipment, military or medical installations. In particular, attention is drawn to any magnetic imaging equipment in hospitals that may be near to urban transport. In all these cases, compatibility must be achieved with consultation and co-operation between the interested parties.

The immunity and emission levels do not of themselves guarantee that integration of the apparatus within the railway will necessarily be satisfactory. The standard cannot cover all the possible configurations of apparatus, but the test levels are sufficient to achieve satisfactory EMC in the majority of cases. In exceptional circumstances, for instance near a “special location” which has unusually high levels of EM interference, the system may require additional measures to be taken to ensure proper operation. The resolution of this is a matter for discussion between the equipment supplier and the project manager, infrastructure controller or equivalent.

The railway apparatus is assembled into large systems and installations, such as trains and signalling control centres. Details are given in annex A. It is not, therefore, possible to establish immunity tests and limits for these large assemblies. The immunity levels for the apparatus will normally ensure reliable operation, but it is necessary to prepare an EMC management plan to deal with complex situations or to deal with specific circumstances. For example the passage of the railway line close to a high power radio transmitter which produces abnormally high field strengths. Special conditions may have to be applied for railway equipment which has to work near such a transmitter and these will be accepted as National Conditions for the specification.

The series of standards IEC 62236, *Railway applications – Electromagnetic compatibility*, contains the following parts:

Part 1: General

This part gives a description of the electromagnetic behaviour of a railway; it specifies the performance criteria for the whole set. A management process to achieve EMC at the interface between the railway infrastructure and trains is referenced.

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

This part sets the emission limits from the railway to the outside world at radio frequencies. It defines the applied test methods and gives information on typical field strength values at traction and radio frequency (cartography).

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

This part specifies the emission and immunity requirements for all types of rolling stock. It covers traction stock and trainsets, as well as independent hauled stock.

The scope of this part of the standard ends at the interface of the stock with its respective energy inputs and outputs.

Part 3-2: Rolling stock - Apparatus

This part applies to emission and immunity aspects of EMC for electrical and electronic apparatus intended for use on railway rolling stock. It is also used as a means of dealing with the impracticality of immunity testing a complete vehicle.

Part 4: Emission and immunity of the signalling and telecommunications apparatus

This part specifies limits for electromagnetic emission and immunity for signalling and telecommunications apparatus installed within a railway.

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

This part applies to emission and immunity aspects of EMC for electrical and electronic apparatus and components intended for use in railway fixed installations associated with power supply.

RAILWAY APPLICATIONS – ELECTROMAGNETIC COMPATIBILITY –

Part 1: General

1 Scope

1.1 This part of IEC 62236 outlines the structure and the content of the whole series.

Annex A describes the characteristics of the railway system which affect electromagnetic compatibility (EMC) behaviour.

Phenomena excluded from this series are nuclear EM pulse, abnormal operating conditions and the induction effects of direct lightning strike.

Emission limits at the railway boundary do not apply to intentional transmitters within the railway boundaries.

Safety considerations are not covered by this series of standards.

The biological effects of non-ionising radiation as well as apparatus for medical assistance, such as pacemakers, are not considered in this series.

1.2 This part of IEC 62236 is supplemented by the following specific standards:

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

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

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

IEC 62236-4 *Railway applications – Electromagnetic compatibility – Part 4: Emission and immunity of the signalling and telecommunications apparatus*

IEC 62236-5 *Railway applications – Electromagnetic compatibility – Part 5: Emission and immunity of fixed power supply installations and apparatus*

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 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility (EMC)*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions related to EMC and to relevant phenomena given in IEC 60050-161 apply.

4 Performance criteria

NOTE This clause is based on IEC 61000-6-2.

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

If, as a result of the application of the tests defined in this series of standards, the apparatus becomes dangerous or unsafe, the apparatus shall be deemed to have failed the test.

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 following criteria:

Performance criterion A: The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

Performance criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

5 Management of EMC

The railway is a complex installation with moving sources of electromagnetic energy and the application of the EMC standards in the IEC 62236 series is not a guarantee of satisfactory performance. There may be cases where apparatus has to be positioned in restricted spaces or added to an existing assembly, with the possible creation of environments of unusual severity. All cases shall be considered with respect to a formal plan for the management of EMC. This plan should be established at as early a stage of the project as is possible.

Refer to IEC 62427 for the management process to achieve EMC between rolling stock and train detection systems.

Annex A
(informative)

The railway system

A.1 General

For operating purposes, railways use electrical systems that require very high outputs (up to several MVA) and power electronic systems that are characterised by their non-linearity (producing harmonics).

In an electric railway, the trains must be supplied via sliding contacts from a supply line, called the catenary or overhead, or a trackside conductor rail, which is installed along the track. The current generally returns to the substation via the rails, a separate return conductor or via the earth. The railway is an integrated system in which electricity has many other uses in addition to train propulsion including:

– heating, air conditioning, catering and lighting of passenger coaches with converters on the vehicles. This power is fed along the train by separate conductors;
– signalling and telecommunication systems along the track and between control centres, concerned with the movement of trains;
– computer installations in control centres, linked via trackside routes;
– passenger information systems on vehicles, stations and depots;
– traction within diesel-electric locomotives and multiple units;
– battery traction vehicles.

Hence, problems of EMC arise not only within the locomotive and the power supply but also in these associated systems. Non-electrified traction such as diesel electric traction may also be a source of EM noise.

The normal and disturbed working of these systems may be a source of electromagnetic noise which can affect all other systems.

A.2 General coupling mechanisms

The coupling between systems is by the well-known physical phenomena and limits are expressed in terms of these phenomena.

Five modes of coupling are distinguished:

– electrostatic coupling, in which a charged body is discharged to a victim circuit;
– capacitive coupling, in which the varying voltage in one circuit produces voltage changes in a victim circuit via mutual capacitance;
– inductive coupling, in which a varying magnetic field produced by a current in one circuit, links with a victim circuit, inducing a voltage via mutual inductance;
– conductive coupling, in which the source and victim circuits share a common conduction path;
– electric (E) and magnetic (H) radiation, in which the circuit structures act as antennas transmitting and receiving energy.

A.3 Principal electromagnetic phenomena for immunity

A.3.1 Conducted low frequency phenomena

Slow variations of the supply voltage including dips, surges, fluctuations, unbalance, harmonics, intermodulation products, data transfer carried on the power supply, power frequency variations, induced low frequency voltages and d.c. in a.c. networks.

A.3.2 Low frequency field phenomena

Magnetic fields, both steady and transient. Electric fields.

A.3.3 Conducted high frequency phenomena

Unidirectional and oscillatory transients, as single events or repetitive bursts. Induced currents.

A.3.4 Radiated high frequency phenomena

Magnetic fields. Electric fields. Radio frequency radiated waves.

A.4 Principal electromagnetic phenomena for emission

In principle, the same phenomena exist as are listed for immunity, but limits have only been applied to the following:

– magnetic fields produced by power frequency and harmonic frequency currents, up to 9 kHz;
– voltage fluctuations produced by power frequency and harmonic currents;
– radio frequency fields produced by trains.

A.5 Description of the different electric traction systems

Direct current and alternating current sources are used.

DC systems include:

– high voltage: 3 000 V
– medium voltage: 1 500 V
– low voltage: from 600 V to 1 400 V, including more particularly urban transit systems.

AC systems include:

– industrial frequency: 50/60 Hz at 20/25 kV or autotransformer 50/25 kV
– low frequency: 16,7 Hz at 15 kV.

Isolated three phase lines exist with two overhead conductors.

A.6 Components of electric traction systems

Traction power is generally supplied from the high voltage national or railway grid systems at voltages up to 400 kV. Connection points, known as sub-stations, perform the following functions:

– protection (circuit breakers) for both public and railway interests;