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INTERNATIONAL STANDARD

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Railway applications – Compatibility between rolling stock and train detection systems

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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS – COMPATIBILITY BETWEEN ROLLING STOCK AND TRAIN DETECTION SYSTEMS

FOREWORD

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IEC 62427 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways. It is an International Standard.

This document is based on EN 50238-1:2019.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) generic compatibility process, which is broken into a two-stage process depending on whether there are established compatibility limits or not;
b) rules for characterization of train detection systems;

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c) rules for characterization of rolling stock;

d) rules for characterization of the power system;

e) informative references are provided in notes to established CENELEC standards for compatibility;

f) terminology is updated.

The text of this International Standard is based on the following documents:

Draft	Report on voting
9/3115/FDIS	9/3142A/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn, or
- revised.

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INTRODUCTION

This document defines a process to demonstrate compatibility between rolling stock operating on an area of use or network and train detection systems installed in this area of use or network.

Currently, general rules for the maximum levels of interference allowed, and maximum susceptibility levels (or minimum required immunity levels) are not established in every country. This is due to the great diversity of rolling stock, power supply and return current systems, and train detection systems installed in each country. This diversity leads to consideration of compatibility of rolling stock and train detection systems on a "route by route" or "network by network" basis, to avoid unnecessarily restrictive specifications.

The compatibility process described in this document is generic. The process refers to all types of train detection systems (TDS), which may be influenced by electromagnetic emissions of rolling stock or traction power supply systems, (e.g. axle counters, track circuits, wheel detectors, loops).

Compatibility is determined by both physical and electromagnetic considerations. With regard to the electromagnetic compatibility, the need is not for general values for maximum levels of interference permitted, and maximum susceptibility levels (or minimum required immunity levels) but for convenient methods by which to specify the level of interference allowed for operation on routes or a network.

Main interference sources are considered to be:

– rail currents and voltage sources;
– electromagnetic fields;
– differential voltage between adjacent axles of the train;

as shown in Figure 1.

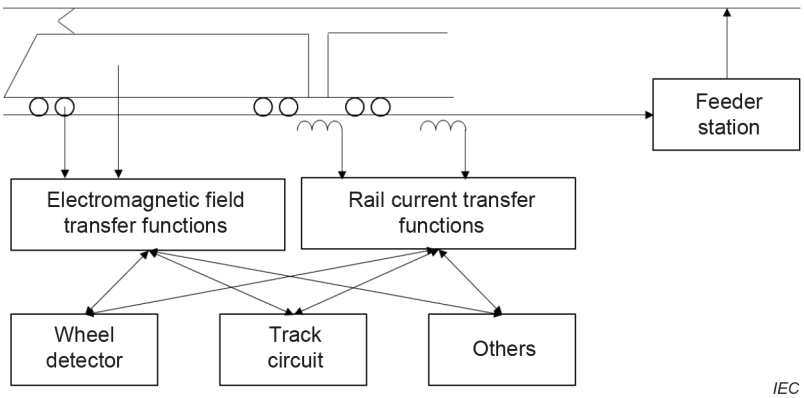

Figure 1 – Sources of electromagnetic interference

In practice, the susceptibility of the system is determined by:

– the sensitivity of individual components of the system and the type of interference it is susceptible to;
– the application of the components, i.e. the configuration of the system.

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Therefore the problems concerning TDS are considered separately for each type.

- National rules or standards, including agreements among stakeholders, define compatibility limits for track circuits;
- National rules or standards, including agreements among stakeholders, define compatibility limits for axle counters and wheel detectors;
- National rules or standards, including agreements among stakeholders, define the testing method of rolling stock for electromagnetic compatibility with axle counters;
- Compatibility with other types of wheel detectors (mechanical or magnetic) is described in 5.4;
- Compatibility with loops can be established following the guidance in 5.5;
- Compatibility with any other type of TDS not explicitly covered by this document can also be established following the generic process in this document.

NOTE 1 In Europe, CLC/TS 50238-2, CLC/TS 50238-3 and EN 50592 provide compatibility limits for track circuits, compatibility limits for axle counters and wheel detectors, and the testing method of rolling stock for electromagnetic compatibility with axle counters, respectively.

For determining the susceptibility of signalling systems, laboratory/simulation testing methods and in situ tests on the "real railway" are proposed. Modelling enables worst-case conditions to be simulated. In addition, particular test sites are selected because, from experience, they are expected to provide the test evidence required.

Then, taking account of the experience of the railways, it is possible to establish a general method for determining the susceptibility of train detection systems, described in this document.

NOTE 2 In Europe, general requirements on how to establish immunity have been defined in EN 50617-1 and EN 50617-2.

Before assessing the electromagnetic emissions of rolling stock, sufficient knowledge of the electric circuit diagram of the power equipment is important, including switching frequencies of on-board power converters, type of regulation used for power converters, resonant frequency of each filter, operating limits under high and low supply voltages, degraded modes of operation.

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RAILWAY APPLICATIONS – COMPATIBILITY BETWEEN ROLLING STOCK AND TRAIN DETECTION SYSTEMS

1 Scope

This document describes a process to demonstrate compatibility between rolling stock (RST) and train detection systems (TDS). It describes the characterization of train detection systems, rolling stock and traction power supply systems.

It is worth noting that the demonstration of technical compatibility between the rolling stock and infrastructure with respect to physical dimensions is not detailed in this document.

This document is not generally applicable to those combinations of rolling stock, traction power supply and train detection system which were accepted as compatible prior to the publication of this document. However, as far as is reasonably practicable, this document can be applied to modifications of rolling stock, traction power supply or train detection systems which can affect compatibility. The detailed process can be used where no rules and processes for compatibility are established.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
competent body
body responsible for the independent evaluation of the compatibility case

Note 1 to entry: This can be an accredited conformity body or an independent safety assessor. This role is not limited to external parties, unless mandated under the applicable legislation.

3.1.2
compatibility case
set of documents which records the evidence demonstrating the degree of compatibility between rolling stock, traction power supplies and train detection systems for a specific route or specific railway network

[SOURCE: IEC 60050-821:2017, 821-03-47]

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3.1.3
degraded modes, pl
modes of operation in the presence of faults which have been anticipated in the design of the signalling system or the rolling stock

[SOURCE: IEC 60050-821:2017, 821-01-52]

3.1.4
traction power supply system
part of the overall electricity energy supply system, not extending beyond the dedicated feeder stations on the rail network

Note 1 to entry: IEC 62313 applies at the interface to the national electricity supply network.

3.1.5
wheel detector
sensor which detects the passage of a wheel

Note 1 to entry: A wheel detector can be used as part of an axle counter or as a treadle.

[SOURCE: IEC 60050-821:2017, 821-03-53]

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

AC	Alternating current
DC	Direct current
IM	Infrastructure manager
MVA	Megavoltampere
NTR	National technical rule
RINF	Register of infrastructure
RST	Rolling stock
TDS	Train detection system
WSF	Wrong side failure

4 Compatibility process

4.1 Overview

The party which introduces a new element or introduces a change of an existing element or system is responsible for demonstrating compatibility between rolling stock, train detection, traction power supply systems and neighbouring infrastructure, if applicable. The party is responsible for initiating the compatibility process. The relevant data shall be made available to the party responsible for constructing and/or amending the compatibility case. If data are not available or not sufficient, alternative arrangements can be made by both the responsible party and the affected party to demonstrate compatibility, for example by carrying out specific compatibility tests. It is recommended that a competent body evaluates the compatibility case if the stakeholders consider the modification to be a significant change. In 4.2 to 4.8, the specific tasks to demonstrate compatibility are listed and explained.

4.2 Detailed compatibility process

The compatibility process is summarized in Figure 2.

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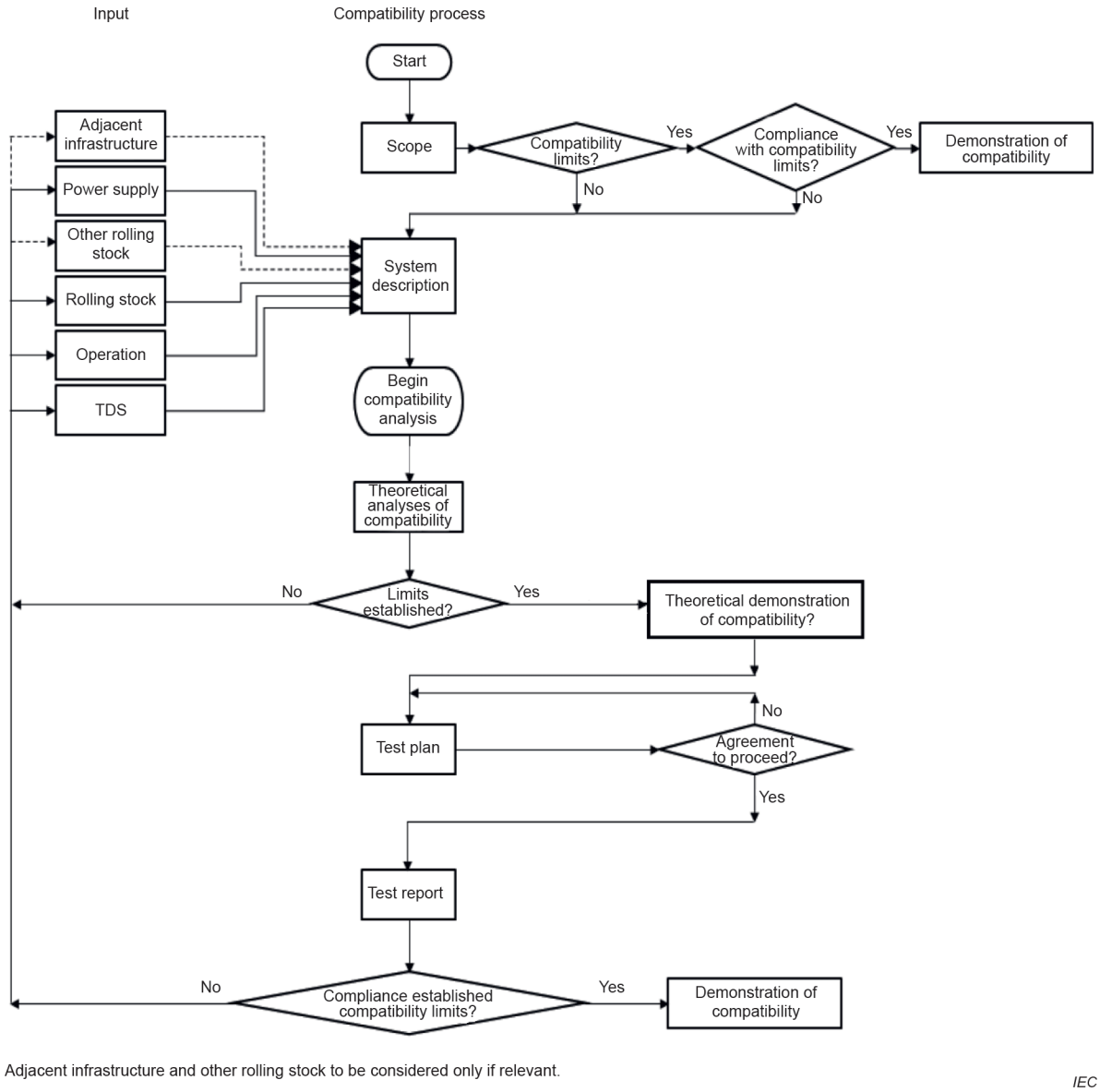

Figure 2 – The compatibility process

4.3 Building the compatibility argument

A compatibility case in compatibility analysis shall be prepared, following the process depicted in Figure 2, including but not limited to the:

a) definition of the scope of the compatibility case, including:
   - new element to be introduced;
   - identification of the route or area of use (network) if applicable;
   - operational conditions;

b) description of the overall rail system including:
   - infrastructure:
     – train detection system (frequency-wide immunity limits if available);
     – track parameters relevant for the train detection system (e.g. earthing and bonding);
     – traction power supply and line parameters;

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- rolling stock in any configuration, including degraded modes:
  - relevant operational conditions e.g. power limitations;
  - factors affecting rolling stock characteristics and compatibility as listed in Annex C, identification of disturbance sources, their behaviour and/or applicable summation rules;
- adjacent infrastructure and other rolling stock, if applicable;

c) theoretical analysis (e.g. simulation) against requirements of the scope including assumptions:
   - derive the permissible interference per on-board source using the analysis in 4.8;

d) test plan taking account of the results of the theoretical analysis;

e) test reports – see Clause 8;

f) assessment of theoretical analysis and test reports against requirements:
   - related compatibility cases;
   - check of validity of assumptions;
   - check if restrictions may be lifted or relaxed;

g) quality management plan and evidence.

If a competent body is appointed, then it is recommended to involve them at each step of the compatibility case.

It is recognized that characterization of interference generated and propagated by rolling stock can be a time consuming process, which may require a significant amount of testing during service operations in order to refine the characteristics. Therefore, provided that the risks to all parties can be demonstrated to be acceptable, temporary operational conditions may be imposed prior to full compatibility being established.

Hereunder specific aspects of the compatibility case will be further outlined.

4.4 Quality management

Quality management systems shall be in place. The importance of configuration management should be noted.

The configuration state of the relevant infrastructure and rolling stock (including maintenance processes and schedules) shall be recorded and referenced within the compatibility case. Any subsequent changes to these configurations shall lead to an examination of the continued validity of the compatibility case.

4.5 Route identification for introduction of RST (new or changed)

In order to accept a particular rolling stock in respect of a particular route or network, the different types and applications of train detection systems and traction power supply systems, if applicable, on the network or on the route and on adjacent routes which can be affected shall be identified. In addition to the intended operational route(s), alternative route(s), which may be required in the event of disruption to traffic shall also be considered.

4.6 Introduction of infrastructure elements (new or changed)

In order to accept a particular infrastructure change (e.g. TDS or traction power supply) in respect of a particular route or network, the different types of RST, TDS and traction power supply systems on the network or on the route and on adjacent routes, which may be affected, shall be identified.

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