BS EN 50238-1:2019

BSI Standards Publication

Railway applications — Compatibility between rolling stock and train detection systems

Part 1: General

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National foreword

This British Standard is the UK implementation of EN 50238-1:2019. It supersedes BS EN 50238-1:2003, which is withdrawn.

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European foreword

This document (EN 50238-1:2019) has been prepared by CLC/SC 9XA “Communication, signalling and processing systems” of CLC/TC 9X “Electrical and electronic applications for railways”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-09-09
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2022-09-09

This document supersedes EN 50238-1:2003 and all of its amendments and corrigenda (if any).

EN 50238-1:2019 includes the following significant technical changes with respect to EN 50238-1:2003:

Generic compatibility process to be followed irrespective of whether the trigger is a change to the signalling system, rolling stock or the power system:

1) generic Compatibility Process, which is broken into two stage process depending on whether there are established compatibility limits or not;

2) rules for characterization of train detection systems;

3) rules for characterization of Rolling Stock;

4) rules for characterization of the Power System;

5) references are provided to established CENELEC standards for compatibility;

6) terminology is updated.

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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 Europe. 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 Electro Magnetic 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.

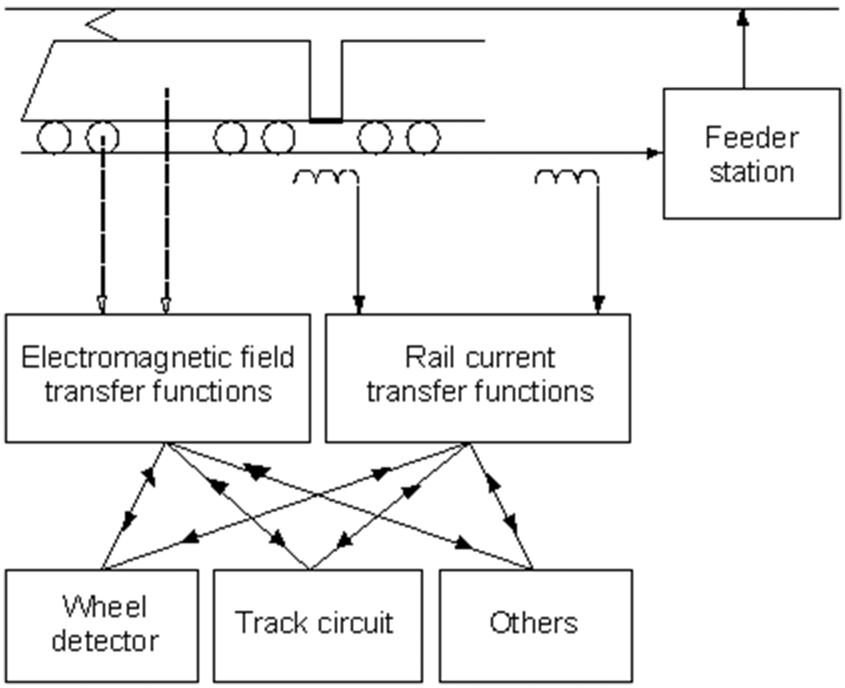

Figure 1 — Sources of electromagnetic interference

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.

- CLC/TS 50238-2 or national rules define compatibility limits for track circuits;
- CLC/TS 50238-3 or national rules define compatibility limits for axle counters and wheel detectors;
- EN 50592 defines 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 explicitely covered by this document can also be established following the generic process in this document.

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. General requirements 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 necessary, 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, etc. EN 50592 defines the testing method of rolling stock for electromagnetic compatibility with axle counters.

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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 issue 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 may affect compatibility. The detailed process can be used where no rules and processes for compatibility are established.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 50617-1, *Railway applications – Technical parameters of train detection systems for the interoperability of the trans-European railway system – Part 1: Track circuits*

EN 50617-2, *Railway Applications – Technical parameters of train detection systems for the interoperability of the trans-European railway system –- Part 2: Axle counters*

EN 50592, *Railway applications – Testing of rolling stock for electromagnetic compatibility with axle counters*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://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 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 mode
mode 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: EN 50388 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 system or as a treadle.

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

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

IM Infrastructure Manager

MVA Mega Volt-Ampere

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 intiating the compatibility process. The relevant data shall be made available to the party responsible for constructing/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 making specific compatibility tests. It is recommended that a competent body assesses the compatibility case if the modification is deemed a significant change. Hereunder the specific tasks to demonstrate compatibility are listed and explained.

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4.2 Detailed compatibility process

The compatibility process is summarized in Figure 2.

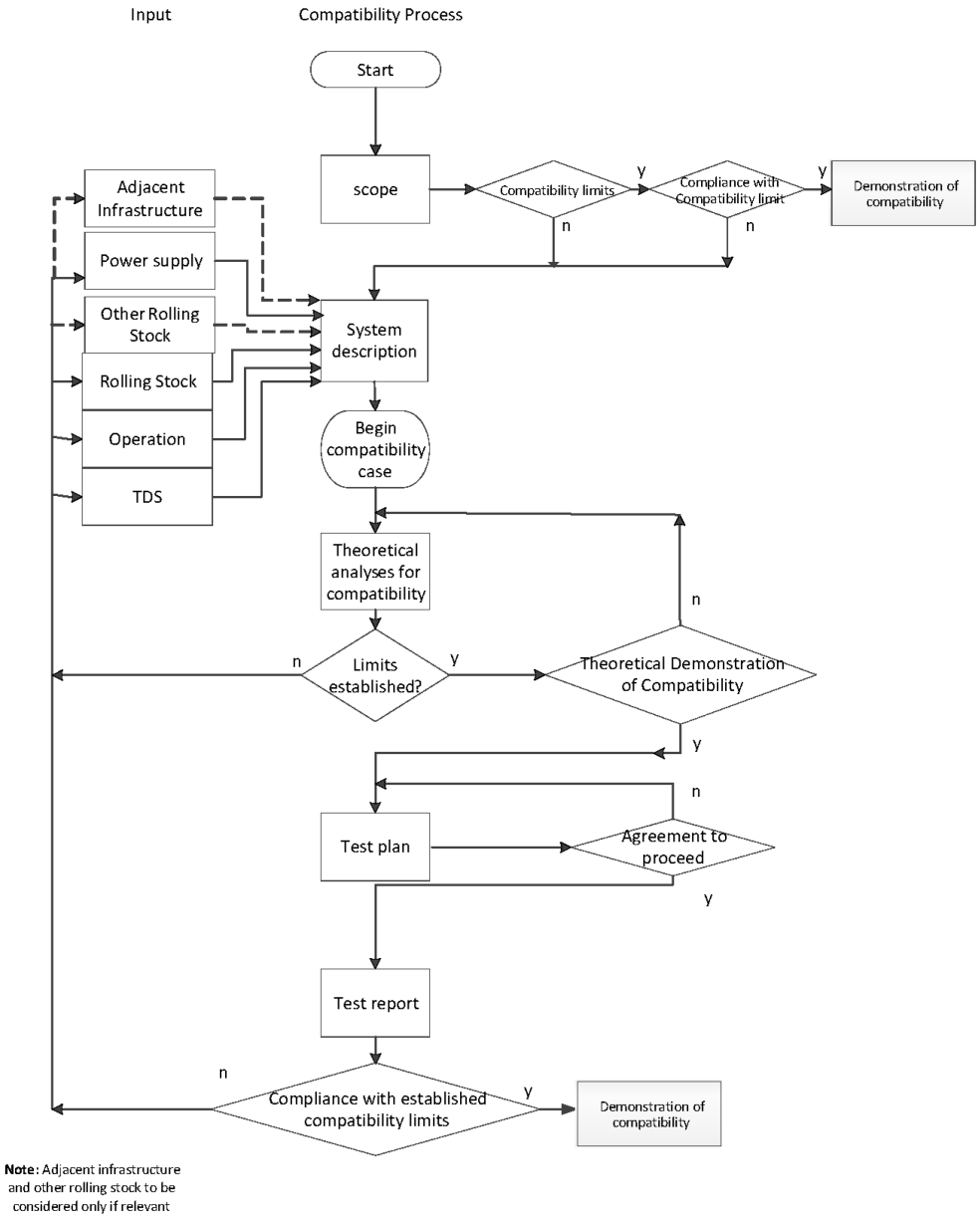

Figure 2 — The compatibility process

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4.3 Compatibility case

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

— 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;

— 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;
  - rolling stock in any configuration, incl. 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;

— 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;

— test plan taking account of the results of the theoretical analysis;

— test reports – see Clause 8;

— 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;

— 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 established.

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

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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 may 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.

4.7 Characterization

The characteristics of the identified systems shall be obtained in accordance with the following clauses:

- For train detection systems: Clause 5;
- For rolling stock: Clause 6;
- For power supply system: Clause 7.

4.8 Compatibility analyses

4.8.1 General terms

It is demonstrated that the rolling stock characteristics for generated and propagated interference comply with the train detection system limits, under defined operating conditions, including degraded modes, such as described in EN 50617-1, EN 50617-2, EN 50592. Their relationship is shown in Figure 3. The information flow may be in either direction depending on which system is to be changed.

NOTE 1 Compatibility is now based on worst-case conditions. This results in very harsh requirements for rolling stock interference limits, while in practice the tolerable interference level is much higher due to overall degradation of older systems and interference produced by the current collecting system. Despite this situation, the cases with hazards caused by interference are very rare. It is obvious that a perspective of risk calculation will ease the interference current requirement by probably a decade.

The safety margin is applicable for safety related tests, where train detection technology implies WSF. The availability margin is applicable for availability related tests. All applicable parameters for compatibility cases of track circuits and axle counters can be identified from EN 50617-1 and EN 50617-2 respectively.

The compatibility analysis is mandatory and shall explain the technical principles which ensure compatibility, including (or giving reference to) all supporting evidence e.g. calculations, test plans and results etc.

The method of analysis of fault modes shall be agreed between the parties listed in 4.3.

The scenario for compatibility including the worst case shall be described with the following parameters:

- transfer function between interference sources (rolling stock and infrastructure) and sensitivity level of the used TDS in the specified frequency band;

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