

TECHNICAL REPORT

**Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS) –
Part 4: RAM risk and RAM life cycle aspects**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS – SPECIFICATION AND DEMONSTRATION OF RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) –**Part 4: RAM risk and RAM life cycle aspects**

FOREWORD

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IEC TR 62278-4, which is a technical report, has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
9/2184/DTR	9/2204A/RVC

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

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

A list of all parts in the IEC 62278 series, published under the general title *Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS)*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

IEC 62278 series *Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS)* is issued for demonstration of the RAMS aspects. It is based on the European Norm EN 50126:1999 that was prepared by Technical Committee CENELEC TC 9X: Electrical and electronic applications for railways. It was submitted to the National Committees for voting under the Fast Track Procedure. This standard is widely used for safety requirements for the safety within the railway field, with relevant safety standards for railway applications such as IEC 62425 and IEC 62279.

For rolling stock, the guidance on applying the RAM requirements in IEC 62278 is issued as IEC TR 62278-3, which is aimed at the customers/operators and main suppliers of rolling stock. The RAM aspects are important for the whole railway systems, not limited to rolling stock. This means that the RAM aspects need to be elaborated upon in the current version of IEC 62278.

IEC technical committee 9 set up Ad-hoc group 9 (AHG 9) with remit to study the possibilities to develop a Technical Report giving input in order to allow the introduction of RAM risk and RAM life cycle aspects in a future revision of EN 50126 by CENELEC TC 9X or of IEC 62278 by IEC TC 9. This technical report is the result of the study in AHG 9 in order to achieve suitable RAM aspects in the future version of IEC 62278.

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RAILWAY APPLICATIONS – SPECIFICATION AND DEMONSTRATION OF RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) –

Part 4: RAM risk and RAM life cycle aspects

1 Scope

This part of IEC 62278 provides an idea for the expansion of the requirements relating only to RAM aspects in IEC 62278.

This document is intended to be used as an input to the revision for the next edition of IEC 62278. This technical report is entirely informative in nature and does not contain normative aspects.

This document details the idea by means of referring to and revising the related clauses of the current edition of IEC 62278.

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.

IEC TR 62278-4:2016

IEC 62278:2002, *Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS)*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 62278 and the following 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 Terms and definitions

3.1.1 impact on operation, comfort or maintenance IOCM

combination of impact on operational capability, impact on passenger's comfort or impact on maintenance

Note 1 to entry: examples of IOCM can be:

- for operational capability: delay, cancelation, stop on the line,
- for passenger comfort: degradation or loss of passenger information, air conditioning, lighting,
- for maintenance: failure without direct impact on operation or comfort, loss of diagnostic system.

3.1.2

potential impact on operation, comfort or maintenance

PIOCM

physical situation with a potential impact on operational capability, passenger's comfort or maintenance

3.1.3

PIOCM Log

document in which all reliability, availability and maintainability management activities, PIOCM identified, decisions made and solutions adopted are recorded or referenced

3.1.4

RAM risk

probable rate of occurrence of a PIOCM causing IOCM and the degree of severity of IOCM

Note 1 to entry: See Annex B for an example of the relation between PIOCM and IOCM.

3.2 Abbreviated terms

IOCM Impact on Operation, Comfort or Maintenance

PIOCM Potential Impact on Operation, Comfort or Maintenance

4 Railway RAM

4.1 General

This clause is about RAM risk. The purpose of this clause is to show that descriptions after 4.2 are intended to be added to Clause 4 in IEC 62278:2002.

The concepts, methods, tools and techniques (e.g. FMEA, FTA, etc.) described in IEC 62278 are considered also applicable for this document.

4.2 RAM risk

4.2.1 RAM risk concept

The concept of RAM risk is the combination of two elements:

- the probability of occurrence of an event or combination of events leading to a PIOCM, or the frequency of such occurrences;
- the consequence of the PIOCM.

4.2.2 RAM risk analysis

4.2.2.1 The bodies or entities in charge should choose whether RAM risk analysis is carried out. RAM risk analysis should be started at the phase 4, and then may need to be updated or repeated at several stages of the life cycle and should be documented by responsible and/or involved bodies or entities for these phases. The documentation should contain:

- a) analysis methodology;
- b) assumptions, limitations and justification of the methodology;
- c) PIOCM identification results;
- d) RAM risk estimation results and their confidence levels;
- e) results of trade-off studies;
- f) data, their sources and confidence levels;
- g) references.

4.2.2.2 Table 1 provides, in qualitative terms, typical categories of probability or frequency of occurrence of a PIOC event and a description of each category for a railway system. The categories, their numbers, and their numerical scaling to be applied should be defined or approved by bodies responsible for the overall railway system, appropriate to the application under consideration.

Table 1 – Example of categories of frequency of occurrence of PIOC events

Category	Description
Frequent	Likely to occur frequently. The PIOC will be continually experienced
Probable	Will occur several times. The PIOC can be expected to occur often
Occasional	Likely to occur several times. The PIOC can be expected to occur several times
Remote	Likely to occur sometime in the system life cycle. The PIOC can reasonably expected to occur
Improbable	Unlikely to occur but possible. It can be assumed that the PIOC may exceptionally occur
Incredible	Extremely unlikely to occur. It can be assumed that the PIOC may not occur

4.2.2.3 Consequence analysis should be used to estimate the likely impact. Table 2 describes typical PIOC severity levels and the consequences associated with each PIOC severity level.

The number of PIOC severity levels and the consequences for each PIOC severity level to be applied and the standard which defines PIOC severity level should be defined or approved by bodies responsible for the overall railway system, appropriate to the application under consideration.

Table 2 – Example of PIOC severity levels

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Example for operation

Severity level	Consequence to service
Significant	Impact on passengers/freight greater than a specified significant level. Examples of events that have such an impact on passengers/freight are: <ul style="list-style-type: none"> – a specific intolerable delay – train cancellation – line interruption (impact on other trains' operation) – skip operation (e.g. failure of station equipment)
Major	Impact on passengers/freight greater than a specified major level and less than a specified significant level. Examples of events that have such an impact on passengers/freight are: <ul style="list-style-type: none"> – a specific undesirable delay – line disturbance (impact on other trains' operation)
Minor	Impact on passengers/freight less than a specified major level (possibly greater than a specified minor level).

Example for comfort

Severity level	Consequence to service
Significant	Impact on passengers greater than a specified significant level. Examples of events that have such an impact on passengers are: <ul style="list-style-type: none"> – loss of ventilation – loss of air conditioning when needed – loss of lighting (e.g. more than 50 %) when needed – loss of passenger information (e.g. loss of announcement function in a whole station or in a whole train) – failure of toilet for people with reduced mobility
Major	Impact on passengers greater than a specified major level and less than a specified significant level. Examples of events that have such an impact on passengers are: <ul style="list-style-type: none"> – partial loss or degradation of ventilation – partial loss or degradation of air conditioning when needed – partial loss or degradation of lighting when needed – partial loss or degradation of visual passenger information – failure of toilet (e.g. half of toilets in train)
Minor	Impact on passengers less than a specified major level (possibly greater than a specified minor level). Examples of events that have such an impact on passengers are: <ul style="list-style-type: none"> – loss of one speaker, one screen, one light, etc.

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Example for maintenance

Severity level	Consequence to service
Significant	Impact on maintenance greater than a specified significant level. Examples of events that have such an impact on maintenance are: <ul style="list-style-type: none"> – restoration which needs important time (e.g. more than 5 days) – re-scheduling the maintenance schedule or inspection schedule (e.g. shorten the inspection interval) – restoration which needs important amount of resources or specific resources with limited capacity
Major	Impact on maintenance greater than a specified major level and less than a specified significant level. Examples of events that have such an impact on maintenance are: <ul style="list-style-type: none"> – restoration which could not be finished until the beginning of next operation period – necessity of more resources without changing maintenance scheme – restoration with logistic issues
Minor	Impact on maintenance less than a specified major level (possibly greater than a specified minor level). Examples of events that have such an impact on maintenance are: <ul style="list-style-type: none"> – maintenance which may be postponed if necessary (e.g. operational constraint) and does not require important/specific time/tools/installations

The number and definition of PIOC severity levels should be scaled depending on the specific application.

4.2.3 RAM risk evaluation and acceptance

4.2.3.1 This subclause deals with the formation of a "frequency – consequence" matrix for evaluation of the results of RAM risk analysis, RAM risk categorisation, actions for RAM risk reduction or elimination of intolerable RAM risks, and for RAM risk acceptance.

4.2.3.2 RAM risk evaluation should be performed by combining the frequency of occurrence of a PIOC event with the severity of its consequence to establish the level of