
**Railway applications — Calculation
of braking performance (stopping,
slowing and stationary braking) —**

**Part 2:
General algorithms utilizing step by
step calculation**

*Applications ferroviaires — Calcul des performances de freinage
(freinage d'arrêt, de ralentissement et d'immobilisation) —*

Partie 2: Algorithmes généraux utilisant le calcul pas à pas





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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 2, *Rolling stock*.

A list of all parts in the ISO 20138 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document describes methodologies for calculation of braking performance such as stopping distance, deceleration, power and energy for railway rolling stock.

The objective of this document is to enable the railway industry and operators to work with common calculation methods.

The ISO 20138 series consists of two parts (ISO 20138-1 and this document) which complement each other.

This document describes the step by step calculation methods for railway applications applicable to all countries. In addition, the algorithms provide a means of comparing the results of other braking performance calculation methods.

The methodology of step by step calculation is based on numerical time integration.

The step by step calculation method cannot be used for stationary braking. This document considers an example for stationary braking of a multiple unit in accordance with ISO 20138-1.

When calculating stopping and slowing distances using the step by step calculation method, it is intended that both ISO 20138-1 and this document be considered.

Railway applications — Calculation of braking performance (stopping, slowing and stationary braking) —

Part 2: General algorithms utilizing step by step calculation

1 Scope

This document specifies the methodologies for calculation of braking performance for railway rolling stock.

This document describes the general algorithms/formulae using instantaneous value inputs to perform calculations of brake equipment and braking performance, in terms of stopping/slowng distances, braking power and energy for all types of rolling stock, either as vehicles or units.

The calculations can be performed at any stage of the assessment process (design, manufacture, testing, verification, investigation, etc.) of railway rolling stock. This document does not set out specific acceptance criteria (pass/fail).

This document is not intended to be used as a design guide for the selection of brake systems and does not specify performance requirements. This document does not provide a method to calculate the extension of stopping distances when the level of demanded adhesion exceeds the available adhesion (wheel slide activity).

This document contains examples of the calculation of brake forces for different brake equipment types and examples of the calculation of stopping distance for vehicles or units.

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.

ISO 20138-1:2018, *Railway applications — Calculation of braking performance (stopping, slowing and stationary braking) — Part 1: General algorithms utilizing mean value calculation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20138-1 and the following apply.

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

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

3.1

slowing distance

s

distance run between the initial brake demand and achieving the final speed v_{fin}

Note 1 to entry: When the final speed $v_{\text{fin}} = 0$ m/s, slowing distance is also known as stopping distance.