



# FINAL DRAFT

## International Standard

### ISO/FDIS 20138-2

## 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*

ISO/TC 269/SC 2

Secretariat: **AFNOR**

Voting begins on:  
**2025-09-24**

Voting terminates on:  
**2025-11-19**

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

ISO/FDIS 20138-2

<https://standards.iteh.ai/catalog/standards/iso/f0c6d6f7-74a5-460a-8a07-e7c777184f74/iso-fdis-20138-2>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

Page

<b>Foreword</b>	<b>iv</b>
<b>Introduction</b>	<b>v</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms and definitions</b>	<b>1</b>
<b>4 Symbols</b>	<b>2</b>
<b>5 General explanation of step by step calculation</b>	<b>4</b>
5.1 Method	4
5.2 Braking force models	4
5.3 Algorithm	5
5.3.1 General description	5
5.3.2 Time integration	5
5.3.3 Determination of time step by checking relative distance deviation, $\xi$	6
5.3.4 Equivalent system response time, $t_{a,e}$	7
5.3.5 Equivalent brake deceleration, $a_{f,e}$	7
5.4 Supplementary dynamic calculations	7
5.4.1 Energy dissipated by each brake equipment type, $W_{B,n}$	7
5.4.2 Value of the required wheel/rail adhesion for the braked wheelset, $\tau_{ax}$	7
5.4.3 Maximum braking power of each brake equipment type, $P_{max,n}$	8
<b>6 Considerations for stopping or slowing distances and deceleration calculations</b>	<b>8</b>
6.1 Accuracy of input values	8
6.2 Distance calculations	8
6.3 General characteristics	8
6.4 Brake equipment type characteristics	8
6.4.1 General	8
6.4.2 Input data	9
6.5 Initial and operating characteristics	9
6.5.1 Nominal conditions	9
6.5.2 Wheel diameter	9
6.5.3 Initial speed	9
6.5.4 Gradient	9
6.5.5 Level of the brake demand	9
6.5.6 Degraded mode	9
6.5.7 Degraded condition	9
6.5.8 Available coefficient of wheel/rail adhesion	10
6.6 Other deceleration calculations	10
6.6.1 General	10
6.6.2 Decelerations resulting from the force generated by each brake equipment type, $a_{j,n}$	10
6.6.3 Mean deceleration over a specific speed range, $a_{f(v1, v2)}$ , based on distance	10
<b>7 Immobilization brake calculation</b>	<b>10</b>
<b>Annex A (informative) Workflow of kinetic calculations</b>	<b>11</b>
<b>Annex B (informative) Calculation of braking forces (non-stationary)</b>	<b>12</b>
<b>Annex C (informative) Examples for brake calculation</b>	<b>16</b>
<b>Bibliography</b>	<b>26</b>

## 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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](http://www.iso.org/iso/foreword.html).

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

This second edition cancels and replaces the first edition (ISO 20138-2:2019), which has been technically revised.

The main changes are as follows:

- ISO 24478 has been added to Clause 2;
- the former terms 3.1 “slowing distance” and 3.2 “slowing time” have been deleted and this document now refers to ISO 24478 and ISO 20138-1 only in Clause 3;
- [Clause 4](#) “Symbols” has been revised;
- [Clause 5](#) “General explanation of step by step calculation” has been revised;
- [Clause 6](#) “Considerations for stopping or slowing distances and deceleration calculations” has been revised;
- [Annex A](#) “Workflow of kinetic calculations” has been revised;
- [Annex B](#) has been revised and renamed in “Calculation of retarding forces (non-stationary)”;
- [Annex C](#) “Examples for brake calculation” has been revised;
- the Bibliography has been revised.

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](http://www.iso.org/members.html).

## Introduction

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

**iTeh Standards**  
**(<https://standards.iteh.ai>)**  
**Document Preview**

[ISO/FDIS 20138-2](https://standards.iteh.ai/catalog/standards/iso/f0c6d6f7-74a5-460a-8a07-e7c777184f74/iso-fdis-20138-2)

<https://standards.iteh.ai/catalog/standards/iso/f0c6d6f7-74a5-460a-8a07-e7c777184f74/iso-fdis-20138-2>