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Järnvägar – Metoder för beräkning av stoppsträcka och nedbromsningssträcka, samt hållbroms och parkeringsbroms – Del 2: Gradvisa beräkningar för tågset eller enkelfordon

Railway applications – Methods for calculation of stopping and slowing distances and immobilization braking – Part 2: Step by step calculations for train sets or single vehicles

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Europastandarden EN 14531-2:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 14531-2:2015.

Denna standard ersätter SS-EN 14531-6:2009, utgåva 1.

The European Standard EN 14531-2:2015 has the status of a Swedish Standard. This document contains the official English version of EN 14531-2:2015.

This standard supersedes the Swedish Standard SS-EN 14531-6:2009, edition 1.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

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Denna standard är framtagen av kommittén för Järnvägar, SIS/TK 254.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 14531-2

December 2015

ICS 45.060.01

Supersedes EN 14531-6:2009

English Version

Railway applications - Methods for calculation of stopping and slowing distances and immobilization braking - Part 2: Step by step calculations for train sets or single vehicles

Applications ferroviaires - Méthodes de calcul des distances d'arrêt, de ralentissement et d'immobilisation - Partie 2 : Calcul pas à pas pour des compositions de trains ou véhicules isolés

Bahnanwendungen - Verfahren zur Berechnung der Anhalte- und Verzögerungsbremswege und der Feststellbremsung - Teil 2: Schrittweise Berechnungen für Zugverbände oder Einzelfahrzeuge

This European Standard was approved by CEN on 27 June 2015.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 14531-2:2015) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2016, and conflicting national standards shall be withdrawn at the latest by June 2016.

This document supersedes EN 14531-6:2009.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

This series of European standards EN 14531, *Railway applications — Methods for calculation of stopping and slowing distances and immobilization braking* consists of:

— *Part 1: General algorithms utilizing mean value calculation for train sets or single vehicles*;

— *Part 2: Step-by-step calculations for train sets or single vehicles*.

The two parts are interrelated and should be considered together when conducting the step-by-step calculation of stopping and slowing distances.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard describes a common calculation method for railway applications. It describes the general algorithms utilizing step by step calculation for use in the design and validation of brake equipment and braking performance for all types of train sets and single vehicles. In addition, the algorithms provide a means of comparing the results of other braking performance calculation methods.

The EN 14531 series was originally planned to have six parts covering the calculation methodology to be used when conducting calculations relating to the braking performance of various types of railway vehicles under the heading 'EN 14531, *Railway applications – Methods for calculation of stopping, slowing distances and immobilization braking*'. The six parts were as follows:

- Part 1: General algorithms
- Part 2: Application to single freight wagon
- Part 3: Application to mass transit (LRVs and D- and E- MUs)
- Part 4: Application to single passengers coach
- Part 5: Application to locomotive
- Part 6: Application to high speed trains

EN 14531-1 was originally published in 2005 followed by EN 14531-6 which was published in 2009.

Following the publication of these parts, it was decided that a common methodology could be used for parts 2 to 5 and this should be contained under a revised version of Part 1 and Part 6 with a title of '*Railway applications — Methods for calculation of stopping and slowing distances and immobilisation braking — Part 2: Step by step calculations for train sets or single vehicles*' .

EN 14531-1:2005 and EN 14531-6:2009 are referenced in the current TSIs (Freight wagons and Locomotive and passenger RST). The tables of the Annex ZA give the equivalence of the TSI referenced clauses of the original EN 14531 series to the clauses of this issue of EN 14531-1 and EN 14531-2.

1 Scope

This European Standard describes the step-by-step method for the calculation of brake performance utilizing time step integration which may be used for all types of train sets, units or single vehicles, including high-speed, locomotive and passenger coaches, conventional vehicles and wagons.

This European Standard does not specify the performance requirements. It enables the calculation of the various aspects of the performance: stopping or slowing distances, adhesion requirements, force calculations, etc.

This European Standard enables the verification by calculation of the stopping and slowing performance for high-speed and conventional trains operating on high-speed and conventional infrastructure. It may also be used for the detailed investigation of stopping or slowing performance at any design/verification stage.

The proposed method of this standard is based on a numerical time integration algorithm. The standard explains a simple numerical integration scheme in order to provide a useful straightforward example of the proposed method. Other numerical time integration algorithms exist, especially more accurate ones, but they are not in the scope of this standard.

When such methods are used the order of accuracy that they achieve has to be in accordance with this European Standard.

This European Standard also includes examples of distance and other dynamic calculations, see Annex B.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14067-4, *Railway applications - Aerodynamics - Part 4: Requirements and test procedures for aerodynamics on open track*

EN 14478, *Railway applications - Braking - Generic vocabulary*

EN 14531-1, *Railway applications - Methods for calculation of stopping and slowing distances and immobilization braking - Part 1: General algorithms utilizing mean value calculation for train sets or single vehicles*

3 Terms, definitions, symbols and indices

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14478 and EN 14531-1 and the following apply.

3.1.1
step-by-step calculation
numerical method with finite time steps

3.2 Symbols and indices

For the purposes of this document, the general symbols given in Table 1 and indices given in Table 2 apply.

Table 1 — Symbols

Symbol	Definition	Unit
A	Area	m^2
a	Deceleration	m/s^2
D	Wheel diameter	m
F	Force	N
F_B	Braking force	N
ε	Acceptable deviation from v_{fin} used to stop the time step calculation	m/s
g_n	Standard acceleration of free fall = 9,806 65 m/s^2 (refer to ISO 80000-3)	m/s^2
i	Gradient (rising gradient is positive; e.g. for a gradient of 5 ‰, i = 0,005)	-
i_C	Cylinder/unit ratio	-
i_{rig}	Rigging ratio	-
i_{tra}	Transmission ratio	-
m	Mass	kg
n	Quantity	-
p	Pressure	Pa
P	Power of brake equipment	W
r	Radius	m
s	Distance	m
t	Time	s
W_b	Energy dissipated by brake equipment	J
τ	Coefficient of adhesion	-
μ	Coefficient of friction (brake pad or block)	-
η	Efficiency	-