

SVENSK STANDARD

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Järnvägar – Aerodynamik – Del 4: Krav och provningsmetoder för aerodynamik i öppen terräng

Railway applications – Aerodynamics – Part 4: Requirements and test procedures for aerodynamics on open track

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Denna standard ersätter SS-EN 14067-4:2013, utgåva 2.

The European Standard EN 14067-4:2013+A1:2018 has the status of a Swedish Standard. This document contains the official version of EN 14067-4:2013+A1:2018.

This standard supersedes the SS-EN 14067-4:2013, edition 2.

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EUROPEAN STANDARD

EN 14067-4:2013+A1

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2018

ICS 45.060.01

Supersedes EN 14067-4:2013

English Version

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

Applications ferroviaires - Aérodynamique - Partie 4:
Exigences et procédures d'essai pour l'aérodynamique
à l'air libre

Bahnanwendungen - Aerodynamik - Teil 4:
Anforderungen und Prüfverfahren für Aerodynamik
auf offener Strecke

This European Standard was approved by CEN on 21 September 2013 and includes Amendment 1 approved by CEN on 28 August 2018.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

SS-EN 14067-4:2013+A1:2018 (E)

Contents	Page
European foreword.....	4
Introduction	5
1 Scope.....	6
2 Normative references.....	6
3 Terms, definitions and symbols.....	6
3.1 Terms and definitions	6
3.2 Symbols.....	7
4 Requirements on locomotives and passenger rolling stock.....	10
4.1 Limitation of pressure variations beside the track	10
4.1.1 General.....	10
4.1.2 Requirements	10
4.1.3 Full conformity assessment.....	11
4.1.4 Simplified conformity assessment.....	11
4.2 Limitation of slipstream effects beside the track.....	13
4.2.1 General.....	13
4.2.2 Requirements	13
4.2.3 Full conformity assessment.....	15
4.2.4 Simplified conformity assessment.....	15
4.3 Aerodynamic loads in the track bed.....	16
5 Requirements on infrastructure	16
5.1 Train-induced pressure loads acting on flat structures parallel to the track.....	16
5.1.1 General.....	16
5.1.2 Requirements	17
5.1.3 Conformity assessment.....	17
5.2 Train-induced air speeds acting on infrastructure components beside the track.....	17
5.3 Train-induced aerodynamic loads in the track bed	17
5.4 Train-induced air speed acting on people beside the track	17
6 Methods and test procedures	17
6.1 Assessment of train-induced pressure variations beside the track.....	17
6.1.1 General.....	17
6.1.2 Pressure variations in the undisturbed pressure field (reference case)	20
6.1.3 Pressure variations on surfaces parallel to the track.....	29
6.1.4 Effect of wind on loads caused by the train	36
6.2 Assessment of train-induced air flow beside the track.....	37
6.2.1 General.....	37
6.2.2 Slipstream effects on persons beside the track (reference case).....	37

6.2.3	Slipstream effects on objects beside the track	40
6.3	Assessment of train-induced aerodynamic loads in the track bed	41
6.4	Assessment of resistance to motion	41
6.4.1	General	41
6.4.2	Full-scale tests	41
Annex A	(informative) Procedure for full-scale tests regarding train-induced air flow in the track bed	45
A.1	General	45
A.2	Track configuration	45
A.3	Vehicle configuration and test conditions	46
A.4	Instrumentation and data acquisition	46
A.5	Data processing	46
Annex ZA	(informative) \square_{A1} Relationship between this European Standard and the essential requirements of EU Directive 2008/57/EC aimed to be covered \square_{A1}	48
Bibliography	50

SS-EN 14067-4:2013+A1:2018 (E)

European foreword

This document (EN 14067-4:2013+A1:2018) 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 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

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

This document includes Amendment 1 approved by CEN on 2018-08-28.

This document supersedes A1 EN 14067-4:2013 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

A1 *deleted text* A1 The results of the EU-funded research project "AeroTRAIN" (Grant Agreement No. 233985) have been used.

A1 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. A1

A1 *deleted text* A1

EN 14067, *Railway applications — Aerodynamics* consists of the following parts:

- *Part 1: Symbols and units*
- *Part 2: Aerodynamics on open track* (A1 *withdrawn* A1)
- *Part 3: Aerodynamics in tunnels*
- *Part 4: Requirements and test procedures for aerodynamics on open track*
- *Part 5: Requirements and test procedures for aerodynamics in tunnels*
- *Part 6: Requirements and test procedures for cross wind assessment*

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Introduction

Trains running on open track generate aerodynamic loads on objects and persons they pass. If trains are being passed by other trains, trains are also subject to aerodynamic loading themselves. The aerodynamic loading caused by a train passing an object or a person near the track, or when two trains pass each other, is an important interface parameter between the subsystems of rolling stock, infrastructure and operation and, thus, is subject to regulation when specifying the trans-European railway system.

Trains running on open track have to overcome a resistance to motion which has a strong effect on the required engine power, achievable speed, travel time and energy consumption. Thus, resistance to motion is often subject to contractual agreements and requires standardized test and assessment methods.

SS-EN 14067-4:2013+A1:2018 (E)

1 Scope

This European Standard deals with requirements, test procedures and conformity assessment for aerodynamics on open track. Addressed within this standard are the topics of aerodynamic loadings and resistance to motion, while the topic of cross wind assessment is addressed by EN 14067-6.

This European Standard refers to rolling stock and infrastructure issues. This standard does not apply to freight wagons. It applies to railway operation on gauges GA, GB and GC according to EN 15273. The methodological approach of the presented test procedures may be adapted to different gauges.

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 1991-2, *Eurocode 1: Actions on structures — Part 2: Traffic loads on bridges*

EN 15273 (all parts), *Railway applications — Gauges*

EN 15663, *Railway applications — Definition of vehicle reference masses*

ISO 8756, *Air quality — Handling of temperature, pressure and humidity data*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1

peak-to-peak pressure change

modulus of the difference between the maximum pressure and the minimum pressure for the relevant load case

3.1.2

passage of train head

passage of the front end of the leading vehicle which is responsible for the generation of the characteristic pressure rise and drop, over and beside, the train and on the track bed

3.1.3

Computational Fluid Dynamics

CFD

numerical methods of approximating and solving the equations of fluid dynamics

3.1.4

streamline shaped vehicle

vehicle with a closed and smooth front which does not cause flow separations in the mean flow field greater than 5 cm from the side of the vehicle

3.1.5

bluff shaped vehicle

vehicle that is not streamlined

3.2 Symbols

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

Table 1 — Symbols

Symbol	Unit	Significance	Explanation or remark
b	m	reference length	train width
c	m/s	speed of sound	
C_F	–	coefficient of aerodynamic force	
C_{p1}	–	aerodynamic coefficient depending on the distance from track centre Y	
C_{p2}	–	aerodynamic coefficient depending on the height above top of rail h	
C_{p3}	–	aerodynamic coefficient depending on the distance from track centre Y	
C_1	N	rolling mechanical resistance	
$C_2 v_{tr}$	N	momentum drag due to air flow for traction and auxiliary equipment and the air conditioning systems	
$C_3 v_{tr}^2$	N	aerodynamic drag in the resistance to motion formula	
dt	s	temporal variation	
dv_{tr}	m/s	train speed variation	
dx	m	spatial variation	
F	N	load on an object, maximum value of the force during the passage	
g	m/s^2	acceleration due to gravity	
h	m	height above top of rail	
i	‰	gradient of the track	
k	–	factor accounting for the energy stored in rotating masses	$\geq 1,0$
k_1	–	shape coefficient of the train	
k_2	–	shape coefficient of the train	
k_3	–	shape coefficient of the train	
L_n	m	length of the train nose	distance from front end to where the full cross section of the leading vehicle is achieved
m	kg	train mass	normal operational payload according to EN 15663