

ICS 45.060.01

English Version

Railway applications - Aerodynamics - Part 7: Fundamentals for test procedures for train-induced ballast projection

Applications ferroviaires - Aérodynamique - Principes
généraux pour des procédures d'essais vis-à-vis des
projections de ballast générées par la circulation des
trains

Bahnanwendungen - Aerodynamik - Grundlagen für
Prüfverfahren für zuginduzierten Schotterflug

This Technical Report was approved by CEN on 19 April 2021. It has been drawn up by the Technical Committee CEN/TC 256.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

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

Contents	Page
European foreword	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	4
4 Symbols and abbreviations	4
5 General aspects of ballast projection and state of the art	4
5.1 Introduction.....	4
5.2 Summary of studies and incidents (by countries, manufacturers)	5
5.3 Overview of ballasted track systems in Europe.....	9
5.4 Ice accumulation induced ballast projection.....	15
6 Economic judgement of damage	18
6.1 Cost of reported damage	18
6.2 Cost of homologation, measures to rolling stock and infrastructure	22
6.3 Cost benefit analysis	26
7 Homologation concepts	27
7.1 General.....	27
7.2 Existing technical approaches.....	27
7.3 Responsibilities, interests and intended interface definitions.....	28
7.4 Conceptual approaches.....	29
8 Comparison of existing methods	32
8.1 France.....	32
8.2 Spain	36
8.3 Italy	46
8.4 Belgium.....	47
8.5 Other countries.....	47
8.6 Comparison of existing methods.....	48
8.7 Conclusion drawn from French and Spanish assessments	48
9 Available background	48
10 Conclusion and next steps	49
Annex A (informative) Summary comparison of existing methods addressing ballast projection	51
Annex B (informative) Review of ballast projection papers	56
Bibliography	103

European foreword

This document (CEN/TR 14067-7:2021) has been prepared by Technical Committee CEN/TC 256 “Railway Applications”, the secretariat of which is held by DIN.

This document is a preview generated by EVS

1 Scope

This document discusses:

- economic aspects of ballast projection;
- comparison of methods in France and Spain for rolling stock;
- infrastructure assessment methods;
- review of available literature;
- next steps and recommendations regarding standardization and research.

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.

EN 14067-4:2013+A1:2018, *Railway applications - Aerodynamics - Part 4: Requirements and test procedures for aerodynamics on open track*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14067-4 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 <https://www.electropedia.org/>

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in EN 14067-4 apply.

5 General aspects of ballast projection and state of the art

5.1 Introduction

The phenomenon of ballast projection has been caused in the past by lumps of ice or accreted snow falling from the train structure during extreme winter conditions, which then strike the ballast bed causing ballast to be ejected upwards, impacting the train underside or passing trains and leading to damage. Typically, this damage includes breakage of train underbody equipment, failures of train systems or reduced efficiencies, breakages of station or train windows, and impact damage to train or trackside structures. This type of ballast projection occurs to regional trains as well as to high speed trains and has been well-known for a long period in railways world-wide.

However, in the early 2000s there were a number of significant incidents of ballast projection involving high speed trains which were not caused by ice fall, but seemed to arise from aerodynamic causes. Substantial damage was caused to the underside of an ICE 3 train in one particular incident in Belgium in 2003. This phenomenon seems to be solely a high speed train phenomenon. The relevant contributory factors involve: