International Standard

ISO 18318

Railway applications — Wheel-rail contact geometry parameters — Definitions and methods for evaluation

Applications ferroviaires — Paramètres géométriques du contact roue-rail — Définitions et méthodes de détermination

First edition
2026-02

Reference number
ISO 18318:2026(en)

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Published in Switzerland

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Foreword

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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 document 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).

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This document was prepared by the European Committee for Standardization (CEN) (as EN 15302:2021) and was adopted, with corrections and additions by Technical Committee ISO/TC 269, *Railway applications*.

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

Wheel-rail contact geometry is fundamental for explaining the dynamic running behaviour of a railway vehicle, as well as the quasi-static behaviour in curves. Among the parameters which influence the dynamic behaviour of a railway vehicle, the equivalent conicity plays an essential role, since it allows a satisfactory characterization of the wheel-rail contact geometry on straight track and in very large radius curves. A wheelset describes a waveform while running on a track. Klingel's theory, valid for massless and rigid wheelsets with conical profiles and pure rolling on rigid rails, states that the waveform is sinusoidal and its wavelength depends on the cone angle of the wheel profile.

Real wheel profiles are not pure cones, but have changing cone angles across the tread, leading to a nonlinear dependency of the rolling radius difference on the lateral movement of the wheelset on the track. The wavelength of the wheelset movement according to the nonlinear kinematic equations of motion can be calculated by solving this formula numerically or by specific methods for linearization of the rolling radius difference function. Equivalent conicity is evaluated by comparison of this wavelength with the equivalent wavelength of a conical wheelset according to Klingel's formula or by calculating the conicity from the linearized rolling radius difference function.

It is important to have a clear specification for the evaluation of wheel-rail contact geometry parameters, which are used in international and national standards and documents (legal and technical).

The objective is to ensure that the results for the determined parameters are consistent. However, it is possible to use different evaluation procedures to those given in this document, provided that the procedure used leads to the determination of wheel-rail contact parameters in accordance with the calculation results using the reference profiles specified in Annex I. A validation process is given in this document to be used in order to determine whether or not an evaluation procedure can achieve the specified reference results.

Railway applications — Wheel-rail contact geometry parameters — Definitions and methods for evaluation

1 Scope

This document establishes definitions and evaluation methods for the following wheel-rail contact geometry parameters influencing the vehicle running dynamic behaviour:

— the rolling radius difference between the two wheels of a wheelset (Δr-function) which serves as a basis for all further calculations;

— the equivalent conicity function from which are derived:

  — a single equivalent conicity value for a specified amplitude, which is relevant for the assessment of vehicle running stability on straight track and in very large radius curves;

  — the nonlinearity parameter, which characterizes the shape of this function and is related to the vehicle behaviour, particularly in the speed range close to the running stability limit;

— the rolling radii coefficient, which is used to describe the theoretical radial steering capability of a wheelset in a curved track.

Additional information is given about the relationship between the contact angles of the two wheels of a wheelset ($\Delta\tan\gamma$-function) and about the roll angle parameter.

NOTE Out of the presented parameters only those related to the contact angle are relevant for independently rotating wheels of wheel pairs.

Descriptions of possible calculation methods are included in this document. Test case calculations are provided to achieve comparable results and to check the proper implementation of the described algorithms.

To validate alternative methods not described in this document, acceptance criteria are given for the equivalent conicity function. This includes reference profiles, profile combinations, tolerances and reference results with tolerance limits.

This document also includes minimum requirements for the measurement of wheel and rail profiles as well as of the parameters needed for the transformation into a common coordinate system of right-hand and left-hand profiles.

This document does not define limits for the wheel-rail contact geometry parameters and gives no tolerances for the rail profile and the wheel profile to achieve acceptable results.

For the application of this document some general recommendations are given.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at http://www.iso.org/obp