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Bahnanwendungen - Parameter der Rad-Schiene Kontaktgeometrie - Definitionen und Berechnungsmethoden

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European foreword

This document (EN 15302:2021) 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of an identical text or by endorsement, at the latest by April 2022, and conflicting national standards shall be withdrawn at the latest by April 2022.

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 supersedes EN 15302:2008+A1:2010.

The main changes with respect to the previous edition are listed below:

— Extension of the Scope;

— Introduction of new wheel-rail contact geometry parameters (rolling radii coefficient, nonlinearity parameter);

— Additional methods for evaluation of equivalent conicity;

— Improvement of the description of the reference profiles;

— Additional reference wheel profile C;

— Reference results based on analytical solutions;

— Hints for plausibility checking of measured profiles;

— Revised assessment of the smoothing process;

— New assessment of the complete process.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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, 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 the United Kingdom.

Introduction

This document is based on the UIC Code 519 OR submitted to CEN by the International Union of Railways (UIC) and which has been revised by CEN/TC 256/WG 10 “Vehicle/Track Interaction”.

The 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 rail vehicle, the equivalent conicity plays an essential role since it allows for the satisfactory characterization of the wheel-rail contact geometry on tangent track and on very large-radius curves. A wheelset describes a waveform while running on a track. Klingel’s theory, valid for massless wheelsets with conical profiles, 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 may be calculated by solving numerically this formula 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 European 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.

Technical background will be given in a Technical Report published after the publication of this document.

1 Scope

This document establishes definitions and evaluation methods for 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 according to EN 14363;

  — 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- 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

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 13231-2:2020, *Railway applications — Track — Acceptance of works — Part 2: Acceptance of reprofiling rails in plain line, switches, crossings and expansion devices*