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Železniške naprave - Kolesne dvojice in podstavni vozički - 3. del: Metoda za načrtovanje osi z zunanjimi ležaji za mestno železnico

Railway applications - Wheelsets and bogies - Part 3: Design method for axles with external journals for urban rail

Bahnanwendungen - Radsätze und Drehgestelle - Teil 3: Konstruktionsleitfaden für außengelagerte Radsatzwellen für städtische Schienenbahnen

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ICS:

45.040	Materiali in deli za železniško tehniko	Materials and components for railway engineering

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European foreword

This document (CEN/TS 13103-3:2026) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

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.

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Introduction

EN 13103-1 is used for the design of wheelset axles of railway vehicles. The load assumptions in this standard refer to mainline vehicles and “normal” European conditions. Operating experience has shown that the use of EN 13103-1 in urban rail vehicles also results in wheelset axles suitable for operation. EN 13103-1 remains the basis for the minimum requirements for an axle to fulfill.

EN 13103-1 requires that, before using this European Standard, if there is any doubt as to whether the railway operating conditions are “normal”, it is necessary to determine whether an additional design factor has to be applied to the maximum permissible stresses.

In this context, recent investigations[1] have shown that parameters for load assumptions and their combination defined in EN 13103-1 may not represent accurately all urban rail operation (network with low curve radius, payload rate, etc.). Therefore, based on recent research projects in Germany and other “state-of-the-art” investigations in the European railway sector, additional design methods have been defined. These methods rely on a different approach than the one defined in EN 13103-1 (infinite lifetime fatigue calculation).

When no extensive technical or operational data are available, refer to EN 13103-1.

When measurements or operational parameters (network characteristics, realistic payload, rolling stock architecture, wheelset mileage…) are available and show that the conventional method is not applicable on its own, additional methods can be used.

This document defines the process to assess the operational parameters and their combination in order to decide if EN 13103-1 is applicable or should be complemented by an additional design method.

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Besides, alternative methods based on cumulative damage fatigue approach are described in the context of urban rail application.

These methods and processes are described in this document in order to allow the possibility for wheelset designers to apply it and to collect return of experience for further improvement.

This document was developed with some existing open points such as the weight, the fatigue model and combination of each parameter in the operating index calculation and even their choice. Annex C gives an overview of the technical background used to draft the specification.

The aim of this document is therefore to gather information and data in order to close these open points in a further revision.

[1] Measurements from different R&D projects in Germany shows that the loads prescribed in the EN 13103 series are different to measured loads. Safe and economical design of railway undercarriages (Volume III) Loads in local traffic, BMBF German funding, Fkz:119P0061B, July 2005; Development of a methodology for the synthetic estimation of load collectives of wheelset shafts in local traffic, BMVi German funding, according to research report FE No. 70.859/2011

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1 Scope

This document describes the state of knowledge resulting from Urban Rail experiences regarding the design of the axle, and further steps to be investigated.

CEN-CENELEC Guide 26 from 1st of June 2013 defines Urban Rail Systems.

This document:

— is applicable for the assessment of new axle designs for urban rail vehicles;

— defines EN 13103-1 as basic calculation method[2];

— defines the calculation procedure of an operational index depending on track layout, payload, mileage, position of the wheelset axle in vehicle. This procedure is based on the examination of Europe-wide service experiences and calculations made on urban rail wheelset axles running in Germany[3];

— defines the conditions, reflected in this operational index, under which additional assessment steps may be needed;

— defines these additional assessment steps, including measurements of bending and torsion moments to derive load collectives representative of normal in-service operating conditions and the determination of equivalent stresses.

The design methodologies described in this document have been determined for axles of urban rail rolling stocks running under normal European conditions. If there is any doubt as to whether the railway operating conditions are normal, these methodologies will be adapted.

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This document applies to:

— axles defined in EN 13261:2024;

— axles with outboard bearings;

— powered and non-powered axles;

— solid and hollow axles;

— all track gauges[4].

This document does not apply to tilting vehicles.

The calculation of wheelset axles for special applications (e.g. tamping/lining/levelling machines) may be made according to this document only for the load cases of free-running and running in train formation. This document does not apply to workload cases. They are calculated separately.

[2] When no sufficient technical or operational data is available, EN 13103-1 can be used.

[3] This Technical Specification reflects the state of knowledge resulting from Urban Rail experiences regarding the design of the axle, built-on by subcommittee DIN specially based for this Technical Specification.

[4] If the gauge is not standard, certain formulae need to be adapted, e.g. according to EN 13103-1:2017+A1:2022.

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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 13103-1:2017+A1:2022, *Railway applications - Wheelsets and bogies - Part 1: Design method for axles with external journals*

3 Terms and definitions

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

ISO and IEC maintain terminology 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/

3.1
solidity
parameter characterising the interaction of the network with regard to the rolling stock, given the guiding forces generated when passing through curves with small radii

3.2
unidirectional vehicle
vehicle which guiding wheelset never changes in normal operation, e.g. vehicles with only one leading driver cab always travelling in the same direction

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3.3
bidirectional vehicle
vehicle which guiding wheelset changes depending on the travelling direction, e.g. vehicles with two opposite driver cabs such as metros or EMU's

3.4
mean service conditions
normal operating conditions that are most likely to be encountered in service excluding all exceptional or particular conditions

4 General design process

The major phases for the design of an axle for urban rail application are:

a) Collection of the operational data (network characteristics, expected mileage of the axle…)

b) Assessment of the "Operational index" (*W*) for the application

c) Calculation in accordance with EN 13103-1:2017+A1:2022

d) Assessment of load spectra representative of normal in-service operating conditions to verify the load assumptions

e) Damage accumulation fatigue assessment

Step d) and e) are only carried out under the conditions defined in chapter 7.

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