SLOVENSKI STANDARD
oSIST prEN 17149-1:2021

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Železniške naprave - Ocenjevanje odpornosti konstrukcije železniških vozil - 1. del: Splošno

Railway applications - Strength assessment of railway vehicle structures - Part 1: General

Bahnanwendungen - Festigkeitsnachweis von Schienenfahrzeugstrukturen - Teil 1: Allgemeine Anforderungen für Festigkeitsnachweise (Statik und Ermüdung)

Applications ferroviaires - Évaluation de la résistance des structures de véhicule ferroviaire - Partie 1 : Généralités

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45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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Railway applications - Strength assessment of railway vehicle structures - Part 1: General

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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Contents

Page

European foreword

This document (prEN 17149-1:2021) has been prepared by Technical Committee CEN/TC 256 "'Railway applications", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document is part of the series EN 17149 *Railway applications — Strength assessment of railway vehicle structures*, which consists of the following parts:

- *Part 1: General*
- *Part 3: Fatigue strength assessment based on cumulative damage*

The following part is under preparation:

- *Part 2: Static strength assessment*

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

Introduction

The structural design of rail vehicle structures depends on the loads they are subject to and the characteristics of the materials they are manufactured from. This document provides the basic procedure and criteria for a pragmatic method to be applied for strength assessments.

Because of multiple use cases and different lifetime requirements this document does not define load cases and does not define in which cases or for which kinds of rail vehicles a strength assessment is to be applied.

1 Scope

This document describes the basic terms and definitions as well as general procedures for strength assessment of rail vehicle structures that are manufactured, operated and maintained according to standards valid for rail system applications.

The assessment procedure is restricted to ferrous materials and aluminium.

This document does not define design load cases.

This document is not applicable for corrosive conditions or elevated temperature operation in the creep range.

This document is applicable to all kinds of rail vehicles.

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 17343:2020, *Railway applications — General terms and definitions*

ISO/TR 25901-1:2016, *Welding and allied processes — Vocabulary — Part 1: General terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions, symbols and abbreviations given in ISO/TR 25901-1:2016, EN 17343:2020 and the following terms and definitions, symbols and abbreviations apply.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 General terms and strength related terms

3.1.1
rail vehicle structure
combination of all load carrying parts of a rail vehicle including its substructures and components

3.1.2
corrosive condition
condition in which an operation in corrosive environment causes effects on the material strength values or loss of material

Note 1 to entry: It is presupposed that in railway applications an adequate corrosion protection avoids corrosive conditions for the structure. Corrosive conditions are therefore out of the scope of this document.

3.1.3
finite element analysis
FEA
numerical method for obtaining approximate solutions of partial differential equations subject to boundary conditions

Note 1 to entry: Finite element analysis is a kind of numerical calculation.

[SOURCE: ISO 18459:2015, 3.6, modified – Note 1 to entry has been changed]

3.1.4
partial factor
factor considering uncertainties of loads (forces), material, model, geometry, manufacturing, and/or degree of validation

Note 1 to entry: In some of the referenced documents, the partial factor is described with terms as “safety factor” as in EN 12663 series and EN 13749 or partial factor for variable actions (e.g. loads or forces) and for material, model and geometric uncertainties as in ISO 2394.

3.1.5
design load
load or combination of loads which a structure is designed to withstand, incorporating any necessary allowances to account for uncertainties in their values

3.1.6
representative load
load or combination of loads derived from standards, simulations or tests, covering a known set of influences, acting as a basis for the derivation of design load

3.1.7
utilisation
ratio between the acting value – calculated or measured - and the allowable limit value

Note 1 to entry: The values are usually expressed as terms of loads, stresses or strains.

3.1.8
safety category
classification defining the consequences of failure of the single structural detail with respect to the effects on persons, facilities and the environment

[SOURCE: EN 15085-1:2007+A1:2013, 3.17, modified – 'classification' has been added, 'welded joint' has been substituted by 'structural detail']

3.1.9
exceptional load
infrequent load which represents the extremal loads or combination of loads for the relevant operation conditions

Note 1 to entry: Exceptional load is also described with terms 'static load', 'static design load' or 'proof load'.

3.1.10
ultimate load
extremal design load that the structure withstands without rupture or collapse

3.1.11
fatigue load
frequent load or combination of loads which represents the normal relevant operation conditions

3.2 Material related terms

3.2.1
brittle material
material that has a permanent elongation at rupture of $A < 6$ %

Note 1 to entry: Cast iron with lamellar graphite (GJL) and cast aluminium (AC) are examples for brittle material.

3.2.2
ductile material
material, which is not brittle

3.2.3
plastification
load-indicated inelastic strain response from a stress level above the material yield strength

3.2.4
significant permanent deformation
plastification which infringes the functionality of a component or the structure

3.2.5
structural failure
loss of load-carrying capacity in the structure

3.2.6
local yielding
plastic strain in a local area small enough so that no significant permanent deformation occurs

3.2.7
fully operational
completely functional, working and as designed to serve a defined purpose under specific conditions

Note 1 to entry: The term fully operational implies no significant permanent deformation and no need for repair.

3.2.8
survival probability
probability that the structural detail will not fail within a specified operating time

Note 1 to entry: Survival probability is related to the single sided probability of the distribution function.

[SOURCE: ISO 11994:1997, 7.1, modified – 'product' has been changed into 'structural detail'; Note 1 to entry has been added]

3.2.9
shear stress
component of stress coplanar with a material cross section

3.2.10
direct stress
component of a stress tensor which is not shear stress, not indicating a specific orientation

Note 1 to entry: This term is also known as 'normal stress'. The term 'direct stress' is chosen to avoid confusion with an oriented stress component normal (perpendicular) to the weld.

3.2.11
membrane stress
average direct stress which is uniform across the thickness of a plate or shell

3.2.12
bending stress
stress in a shell or plate-like part of a component with linear distribution across the thickness

3.2.13
secondary bending stress
bending stress in a weld throat caused by membrane stress and eccentricity between the weld throat and connected plate midpoint e_W

3.2.14
residual stress
permanent internally balanced stresses in a structure, caused by manufacturing processes (e.g., rolling, cutting or welding)

3.3 Terms related to welding

3.3.1
parent material
material of a structure outside of welded joints

[SOURCE: ISO/TR 25901-1:2016, 2.1.1.5, modified – extension to any material which is not welded]

3.3.2
transverse to the weld
perpendicular to the feature under consideration (e.g., the weld toe)

Note 1 to entry: Stresses and strains longitudinal to the weld are indicated with an index '⊥'.

Note 2 to entry: The stress direction definition 'transverse to the weld' is shown in Figure 1.

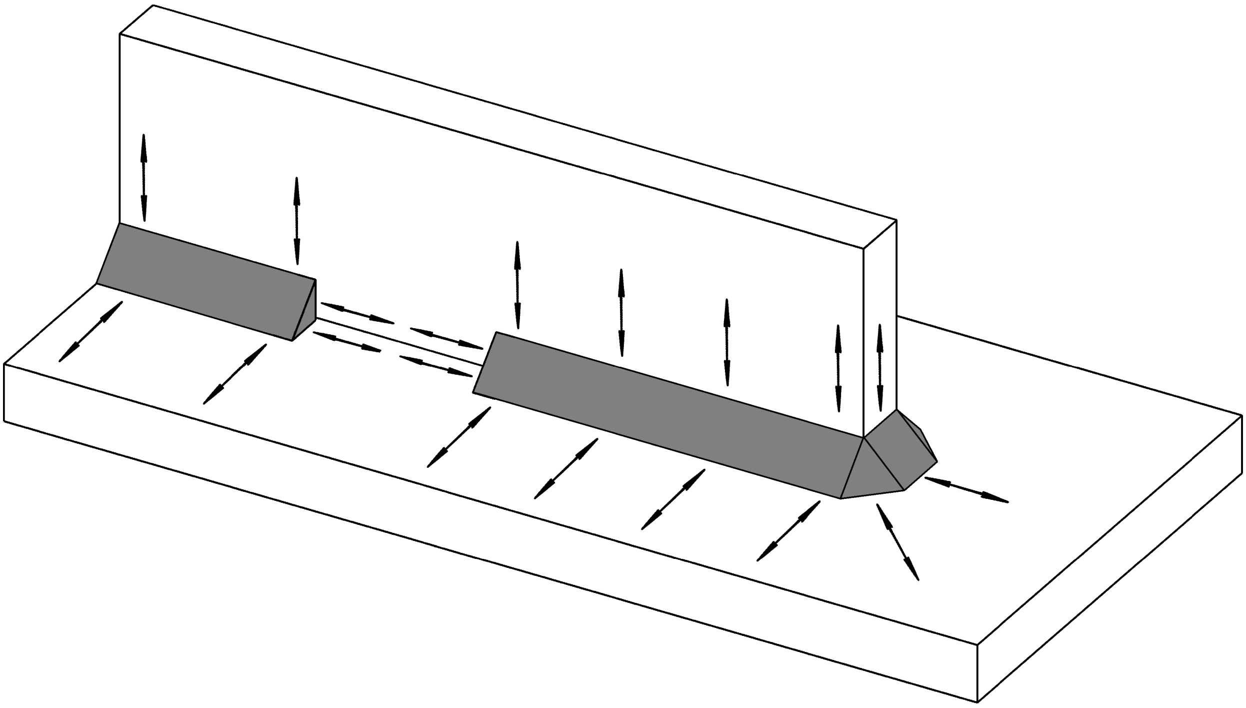


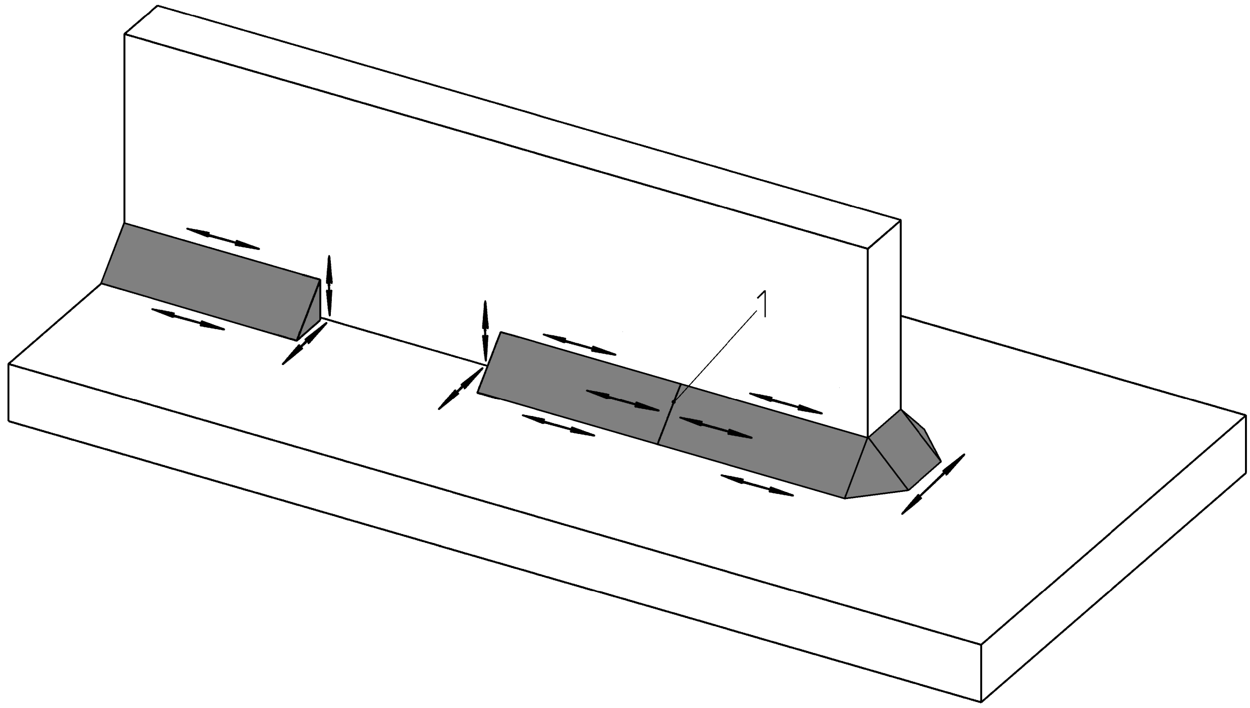
Figure 1 — Stress direction definition transverse to the weld

3.3.3
longitudinal to the weld
aligned with (parallel to) the feature under consideration (e.g., the weld toe)

Note 1 to entry: The stress direction definition 'longitudinal to the weld' is shown in Figure 2.

Note 2 to entry: For the assessment of the weld end the direction 'longitudinal to the weld' is orthogonal to the direction 'transverse to the weld'.

Note 3 to entry: Stresses and strains longitudinal to the weld are indicated with an index 'II'.



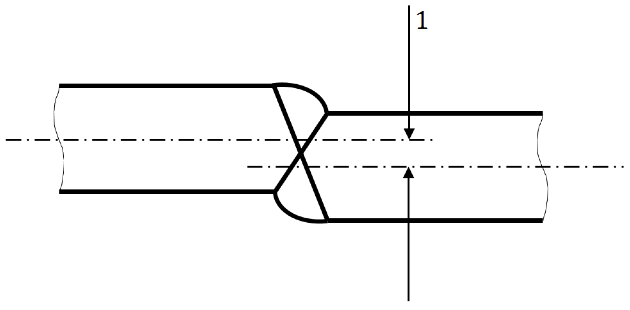
Key

1 stop-/start-position

Figure 2 — Stress direction definition longitudinal to the weld

3.3.4
linear misalignment
axial offset from the nominal geometry of plates within a welded joint

Note 1 to entry: The definition 'linear misalignment' is shown in Figure 3.



Key

1 linear misalignment

Figure 3 — Linear misalignment