SLOVENSKI STANDARD
SIST EN 17976:2025

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Železniške naprave - Vijačenje železniških vozil in komponent

Railway applications - Bolting of rail vehicles and components

Bahnanwendungen - Verschrauben von Schienenfahrzeugen und -fahrzeugteilen

Applications ferroviaires - Boulonnage des véhicules et des composants ferroviaires

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21.060.01	Vezni elementi na splošno	Fasteners in general
45.040	Materiali in deli za železniško tehniko	Materials and components for railway engineering

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Railway applications - Bolting of rail vehicles and components

Applications ferroviaires - Boulonnage des véhicules et des composants ferroviaires

Bahnanwendungen - Verschrauben von Schienenfahrzeugen und -fahrzeugteilen

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Contents

Page

European foreword

This document (EN 17976:2024) 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of an identical text or by endorsement, at the latest by June 2025, and conflicting national standards shall be withdrawn at the latest by June 2025.

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Introduction

Screwed and bolted joints are often used to assemble safety-critical components on rail vehicles. This document sets out key considerations for design and assembly of such joints, based on an assessment of their criticality.

The application of this document results in an appropriate safety level for bolted joints in railway applications considering design, assembling and service phase.

This document gives guidance on the selection and design of bolted joints for rail vehicles in mechanical and electrical applications.

The function of a bolted joint is to connect two or more parts in a sufficient and safe manner over the intended service life under the conditions of the railway environment. The mechanical bolted joint is designed to transmit forces between the connected components without failure, separation or relative movement. The electrical bolted joint is designed to ensure current transmission between electrical conductors safely and without separation or relative movement. For this purpose, the parts are held together by the preload of the bolt.

This document describes the safety categories of bolted joints and gives an overview of the resulting requirements linked to these safety categories.

It specifies standards for the design and verification of bolted joints. Design includes aspects such as joint dimensions, layout, securing of bolted joints and corrosion protection.

It is intended to support the designer in the basic selection of bolted joints for familiarisation with the necessary systematics and terms.

Tightening of bolted joints is a special process in the railway industry in accordance with ISO 22163. Therefore, the conformity of the resulting product cannot be readily determined without destructive analysis prior to use but the influence parameters affecting the process can be controlled. This document provides guidance to control these parameters.

Furthermore, this document specifies requirements for assembly, quality and maintenance.

1 Scope

This document specifies the requirements for designing, strength assessment, assembly and servicing of mechanical and electrical bolted joints made from metallic components and bolts.

This document is not intended for rivets, lock bolts, self-tapping screws, wood screws, thread-rolling screws, thread-forming and chipboards.

This document is applicable to all 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 50343, *Railway applications — Rolling stock — Rules for installation of cabling*

EN 15865, *Adhesives — Determination of torque strength of anaerobic adhesives on threaded fasteners (ISO 10964)*

EN ISO 3506-1, *Fasteners — Mechanical properties of corrosion-resistant stainless steel fasteners — Part 1: Bolts, screws and studs with specified grades and property classes (ISO 3506-1)*

EN ISO 3506-2, *Fasteners — Mechanical properties of corrosion-resistant stainless steel fasteners — Part 2: Nuts with specified grades and property classes (ISO 3506-2)*

EN ISO 4014, *Fasteners — Hexagon head bolts — Product grades A and B (ISO 4014)*

EN ISO 4017, *Fasteners — Hexagon head screws — Product grades A and B (ISO 4017)*

EN ISO 10683, *Fasteners — Non-electrolytically applied zinc flake coating systems (ISO 10683)*

EN ISO 4762, *Hexagon socket head cap screws (ISO 4762)*

EN ISO 10664, *Hexalobular internal driving feature for bolts and screws (ISO 10664)*

ISO 261, *ISO general purpose metric screw threads — General plan*

EN 17149-1:2024, *Railway applications — Strength assessment of rail vehicle structures — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions, symbols and abbreviations given in EN 17149-1:2024 and 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
bolt
fastener with a partially threaded shaft

Note 1 to entry: In this document, when only the term bolt is used, it refers to a bolt or a screw.

3.2
screw
fastener with a fully threaded shaft

3.3
bolted joint
assembly of two or more components held together by the preload of a bolt or screw

Note 1 to entry: The bolted joint contains the clamped components, the bolt or screw, nut and washers. In this document the term bolted joint includes the screwed joint.

3.4
screwed joint
bolted joint with an internally threaded component

Note 1 to entry: The bolt or screw is inserted into a tapped component. A nut is not used. A screwed joint contains the clamped components, the bolt or screw and washers.

3.5
fastener
connective element used in a bolted joint

EXAMPLE Screws, bolts, nuts and washers are considered fasteners.

3.6
separation
full loss of contact in the interface between clamped components

Note 1 to entry: The surface pressure between two clamped components falls to zero due to external loads pulling these parts apart.

3.7
permanent plastic deformation
plastification which infringes the functionality and durability of the bolt

3.8
load factor
ratio of additional bolt load to external load

Note 1 to entry: The load factor is determined using the resilience of the bolt and clamped components.

3.9
loosening
effect which results in loss of preload

3.10
slackening
loss of preload due to embedding, creep or exceeding surface pressure limits

3.11
embedding
flattening of joint surfaces, within the thread, under the head or the nut or the interface surfaces

3.12
creep
time-dependent plastic deformation under load which leads to the loss of preload in bolted joints

Note 1 to entry: In metallic materials, this usually occurs at elevated temperatures (at least 30 % to 40 % of the melting temperature in Kelvin).

3.13
self-acting loosening by rotation
loss of preload due to relative rotational movement between the nut and bolt or screw and threaded part, often associated with external shear loads overcoming the joint friction

3.14
fatigue load
repetitive load or combination of loads

[SOURCE: EN 17149-1:2024, 3.1.14]

3.15
exceptional load
infrequent load which represents the extreme loads or combination of loads for the relevant operation conditions

[SOURCE: EN 17149-1:2024, 3.1.10]

3.16
exceptional design load
design load derived from an exceptional load

[SOURCE: EN 17149-1:2024, 3.1.12]

3.17
ultimate load
extreme load that the structure withstands without rupture or collapse

[SOURCE: EN 17149-1:2024, 3.1.11]

3.18
ultimate design load
design load derived from an ultimate load

[SOURCE: EN 17149-1:2024, 3.1.13]

3.19
failure
loss of function of the bolted joint

Note 1 to entry: Function is e. g. structural strength or current transfer. Depending on design and function this can be an unacceptable loss of preload or total loss of joint.

3.20
slip-resistant
property that prevents relative transverse or radial movement between the clamped components

3.21
tightening factor
ratio between maximum and minimum assembly preload of a bolted joint due to the scatter of the tightening process and scatter of friction coefficients

Note 1 to entry: Reduction of preload due to embedding is not taken into account.

3.22
tightening process
sequence of actions to tighten a bolted joint including all influence parameters

Note 1 to entry: The tightening process does not include the assembly of the bolted joint.

3.23
mechanical connection
bolted joint transferring loads between two or more components

3.24
electrical connection
bolted joint connecting two or more components to transfer current

3.25
severity level
severity of the consequences in case of failure of a bolted joint

3.26
safety class
resistance of a design against the feared consequences in case of failure of the bolt

3.27
safety category
classification defining the consequences of failure of the single bolted joint 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 “bolted joint”]

3.28
load-transmitting equipment
component or assembly which transfers loads during operation

Note 1 to entry: Examples for equipment loads are traction, braking and damper loads.

3.29
protective earthing
current-carrying electrical connection only in the event of a fault

3.30
TN-C
neutral conductor and protective earthing conductor combined in one unique line inside whole system

3.31
PEN-conductor
conductor combining the functions of both a protective earthing conductor and a neutral conductor

3.32
equipotential bonding system
provision of electrical connections between conductive parts intended to achieve equipotentiality

3.33
control parameter
parameter by which the tightening process is terminated

3.34
monitoring parameter
measured parameter used for supervision purposes

3.35
directly measured parameter
measured variable without additional physical transformation

Note 1 to entry: The control/monitoring variable is measured using a traceable calibratable sensor integrated into the fastening tool or fastening system and which supplies measurement signals independently of the fastening process.

3.36
indirectly measured parameter
control or control variable that is not directly measured

Note 1 to entry: e. g., current or pressure shutdown without measurement until the spindle stops.

3.37
manually actuated fastening tool
fastening tool which is unpowered

Note 1 to entry: An example of a manually actuated fastening tool is a manual torque wrench.

3.38
hand-held tightening system
motor-driven tightening system, in which the operator supports the reaction torque

Note 1 to entry: Permanent confirmation is achieved through tactile feedback to the user.

3.39
hand-guided tightening system
motor-driven tightening system, in which the operator does not support the reaction torque

Note 1 to entry: This definition also includes fully automatic robotic systems.

3.40
performance class
classified scatter of control parameter

3.41
torque wrench
handheld indicating or setting torque tool

Note 1 to entry: A tool is considered hand-held in accordance with EN ISO 6789 (series) type I and type II.

3.42
quality process
measures to ensure that the assembly result meets the requirements

3.43
statistical tolerance interval
interval determined from a random sample in such a way that one has a specified level of confidence that the interval covers at least a specified proportion of the sampled population

Note 1 to entry: The confidence level in this context is the long-run proportion of intervals generated in this manner that will include at least the specified proportion of the sampled population.

[SOURCE: ISO 3534-1:2006, 1.26, modified: Added Note 1 to entry]

3.44
statistical tolerance limit
statistic representing an end point of a statistical tolerance interval

Note 1 to entry: Statistical tolerance intervals may be either one-sided (with one of its limits fixed at the natural boundary of the random variable), in which case they have either an upper or a lower statistical tolerance limit, or two-sided, in which case they have both.

4 Symbols and abbreviations

Table 1 lists the symbols and abbreviations used in this document.

Table 1 — Symbols and abbreviations

Symbol	Unit	Designation
A	mm^2	effective area of contact
c	mm	size of chamfer
CP	-	performance class
Cbs	-	Abbreviation for “carbodies”
D	mm	diameter
d	mm	nominal diameter of a thread which corresponds to ISO 261
d_0	mm	outside diameter of the plane head bearing
d_h	mm	diameter of a through hole
d_k	mm	drill sizes for metric threads
E	mm	thread run-out
e_1, e_2	mm	recommended edge distance
F	N	load (force)
F_{ax}	N	axial load
F_M	N	assembly preload when mounting/tightening
F_{sh}	N	shear load