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English Version

## Railway applications - Wheelsets and bogies - Axles - Product requirements

Applications ferroviaires - Essieux montés et bogies -  
Essieux-axes - Prescription pour le produit

Bahnanwendungen - Radsätze und Drehgestelle -  
Radsatzwellen - Produkthanforderungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

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**prEN 13261:2023 (E)****European foreword**

This document (prEN 13261:2023) has been prepared by the CEN/TC 256 “Railway applications” Technical Committee, the secretariat of which is held by DIN.

This document will be submitted to the CEN enquiry.

This document will supersede EN 13261:2020.

This revision includes:

- an improved definition of the product groups submitted to qualification;
- improved requirements to assess product qualification after changes made in the manufacturing process;
- additional possibilities to carry out tests with axle journal extensions.

The informative annexes to this document provide additional guidance that is not mandatory but that helps to understand or use the document.

The informative annexes may contain optional requirements. For example, a test method that is optional, or presented as an example, may contain requirements, but it is not necessary to meet these requirements to be in compliance with the document.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

<https://standards.iteh.ai/catalog/standards/sist/6e6894c4-250d-4038-ae01-175eb39a1fe2/osist-pren-13261-2023>



## 1 Scope

This document specifies the characteristics of axles for all heavy rail track gauges.

This document applies to heavy rail vehicles and applies, in principle, to other vehicles such as urban rail vehicles.

It defines characteristics of forged or rolled solid and hollow axles, made from vacuum-degassed steel grade EA1N<sup>1)</sup>, EA1T<sup>1)</sup> and EA4T<sup>1)</sup>. For hollow axles, this document applies only to those that are manufactured by machining of a hole in a forged or rolled solid axle.

The requirements defined in this document are applicable for cylindrical seats. Most of the requirements are also applicable for axles with conical seats. Specific requirements for conical seats (e.g. geometrical dimensions of the seats...) are defined in the technical specification.

Some characteristics are given as a function of a category 1 or of a category 2.

This document is applicable to axles that are designed in accordance with the requirements of EN 13103-1:2017+A1:2022.

This document also permits variations of the material characteristics linked to alternative manufacturing processes (e.g. cold rolling, shot blasting, thermal spraying, steel cleanliness, reduction ratio, improved material properties from melting and heat treatment process, etc.).

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

EN 22768-1:1993, *General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (ISO 2768-1:1989)*

EN ISO 22081:2021, *Geometrical product specifications (GPS) - Geometrical tolerancing - General geometrical specifications and general size specifications (ISO 22081:2021)*

EN ISO 148-1:2016, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1)*

EN ISO 643:2020, *Steels - Micrographic determination of the apparent grain size (ISO 643:2019, Corrected version 2020-03)*

EN ISO 11997-1:2017, *Paints and varnishes - Determination of resistance to cyclic corrosion conditions - Part 1: Wet (salt fog)/dry/humid (ISO 11997-1:2017)*

EN ISO 2409:2020, *Paints and varnishes - Cross-cut test (ISO 2409:2020)*

EN ISO 2808:2019, *Paints and varnishes - Determination of film thickness (ISO 2808:2019)*

EN ISO 4624:2016, *Paints and varnishes - Pull-off test for adhesion (ISO 4624:2016)*

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1) N for a normalized metallurgical condition

T for a quenched and tempered metallurgical condition

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EN ISO 6507-1:2018, *Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1:2018)*

EN ISO 6892-1:2019, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1:2019)*

EN ISO 9227:2022, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227:2022)*

EN ISO 14284:2022, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284:2022)*

EN ISO 16276-2:2007, *Corrosion protection of steel structures by protective paint systems - Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating - Part 2: Cross-cut testing and X-cut testing (ISO 16276-2:2007)*

ISO 4967:2013, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams*

ISO 5948:2018, *Railway rolling stock material — Ultrasonic acceptance testing*

ISO 6933:1986, *Railway rolling stock material — Magnetic particle acceptance testing*

ISO/TR 9769:2018,<sup>2</sup> *Steel and iron — Review of available methods of analysis*

**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, available at the following addresses:

- IEC Electropedia: available at <https://www.iso.org/obp/1:2023>  
<https://standards.iteh.ai/catalog/standards/sist/6e6894c4-250d-4038-ae01->
- ISO Online browsing platform: available at <https://www.electropedia.org/>

**3.1 technical specification**

document describing specific parameter and/or product requirements as an addition to the requirements of this document

**3.2 batch**

composed of axles supposed to have the same characteristics

Note 1 to entry: A batch consists of axles of the same design forged or rolled with raw material of a single heat in an identical hot forming process and heat treated at the same time in an identical procedure. If the raw material is produced in several heats with the expected chemical composition, the axles made thereof can be combined to a batch. In this case, it needs to be proven within the frame of the product qualification that the axles made of the various heats comply with the requirements of the product qualification.

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<sup>2)</sup> See also CEN/TR 10261:2019.

### 3.3

#### axle categories

classification of the component, based on operational aspects, which determines the list of requirements to be applied

Note 1 to entry: Category 1 is generally selected when the operating train speed is greater than 200 km/h.

Note 2 to entry: Category 2 is generally selected when the operating speed is 200 km/h or less.

Note 3 to entry: These categories can also be defined according to the technical specification.

## 4 Product definition

### 4.1 Chemical composition

#### 4.1.1 Values to be achieved

The values for percentage contents of the various elements shall be in accordance with Table 1.

**Table 1 — Limit values by product analysis**

Grade	C %	Si %	Mn %	P <sup>a</sup> %	S <sup>a b</sup> %	Cr %	Cu %	Mo %	Ni %	V %
EA1N	≤ 0,40	≤ 0,50	≤ 1,20	≤ 0,020	≤ 0,015 <sup>ab</sup>	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,30	≤ 0,06
EA1T	≤ 0,40	≤ 0,50	≤ 1,20	≤ 0,020	≤ 0,015 <sup>ab</sup>	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,30	≤ 0,06
EA4T	≥ 0,22 ≤ 0,29	≥ 0,15 ≤ 0,40	≥ 0,50 ≤ 0,80	≤ 0,020	≤ 0,015 <sup>b</sup>	≥ 0,90 ≤ 1,20	≤ 0,30	≥ 0,15 ≤ 0,30	≤ 0,30	≤ 0,06
<sup>a</sup> A maximum content of 0,025 % may be agreed in the technical specification. <sup>b</sup> A minimum sulphur content may be agreed in the technical specification according to the steelmaking process, in order to safeguard against hydrogen embrittlement.										

#### 4.1.2 Sampling methods

The test sample shall be taken at mid-radius of solid axles or at mid-distance between external and internal surfaces of hollow axles.

The chemical composition can alternatively be determined by ladle analysis.

For forged axles, when defined in the technical specification, the sample may be taken from an axle journal extension as stated in Annex A.

#### 4.1.3 Chemical analysis

The chemical composition analysis shall be performed according to the methods and definitions described in ISO/TR 9769 unless another standard is defined in the technical specification.

NOTE ASTM E415-14 and ASTM E1019-11 can be applied.

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## 4.2 Mechanical characteristics

## 4.2.1 Characteristics from the tensile test

## 4.2.1.1 Values to be achieved

The values to be achieved at mid-radius of solid axles or at mid-distance between external and internal surfaces of hollow axles are given in Table 2.

The values to be achieved near the external surface shall be greater than or equal to 0,95 times the values measured at mid-radius of solid axles or at the mid-distance between external and internal surfaces of hollow axles.

The values to be achieved in the centre of solid axles or near the internal surface of hollow axles shall be greater than or equal to 0,8 times the values measured at mid-radius or at mid-distance between external and internal surfaces.

**Table 2 — Values to be achieved at mid-radius of solid axles or at mid-distance between external and internal surfaces of hollow axles**

Grade	$R_{eH}$ <sup>a</sup> MPa	$R_m$ MPa	$A_5$ %
EA1N	≥ 320	550 - 650	≥ 22
EA1T	≥ 350	550 - 700	≥ 24
EA4T	≥ 420	650 - 800	≥ 18

<sup>a</sup> If no distinctive yield strength is present, the proof stress  $R_{p0,2}$  shall be determined.

## 4.2.1.2 Position of the test pieces

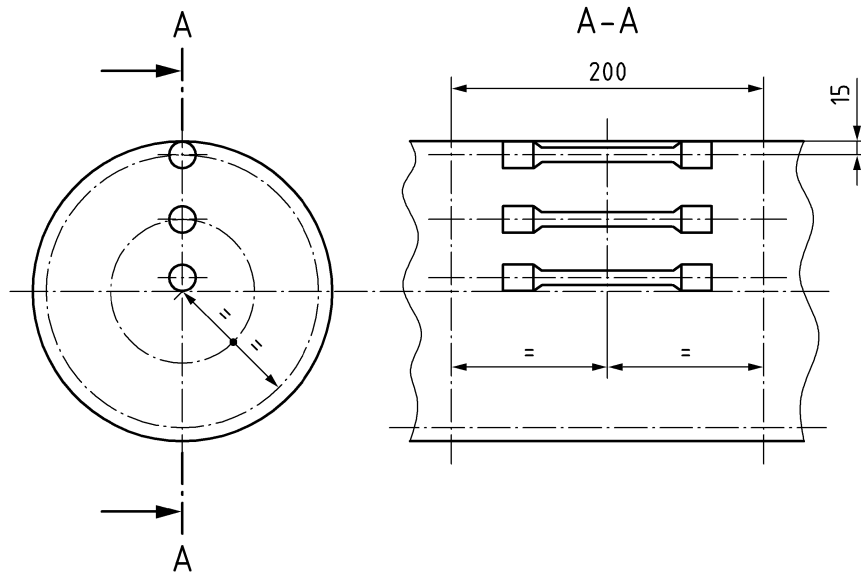
The test pieces shall be taken at three levels from the largest diameter section of the axle

- as near as possible to the external surface for all the axles,
- at mid-radius and in the centre of solid axles,
- at mid-distance between external and internal surfaces, and near the internal surface of hollow axles,

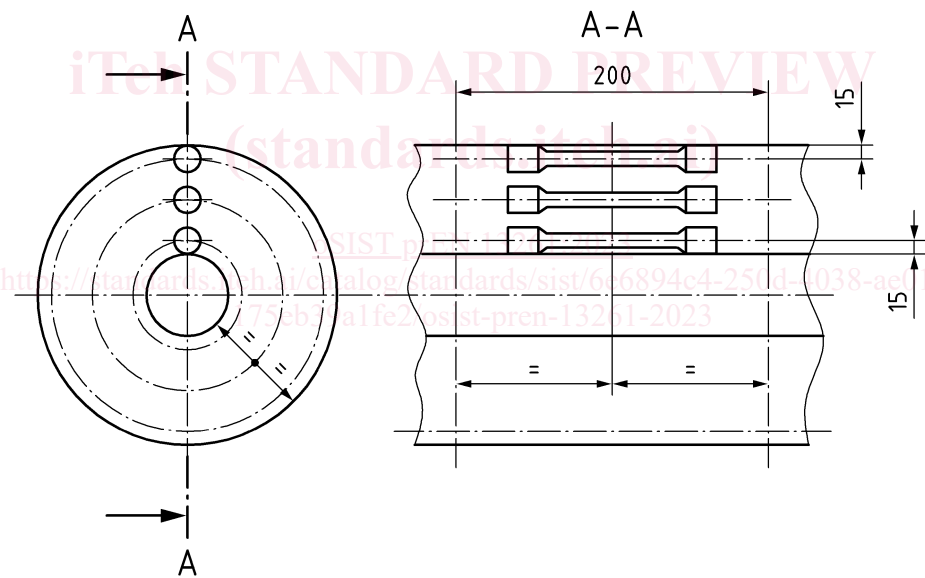
as shown in Figure 1 a) and b).

For forged axles, when defined in the technical specification, the sample may be taken from an axle journal extension as stated in Annex A.

Dimensions in millimetres



a) — Solid axle



b) — Hollow axle

Figure 1 — Position of test pieces

#### 4.2.1.3 Test method

The test shall be carried out in accordance with EN ISO 6892-1. The test piece diameter shall be at least 10 mm in the machined-down portion. The gauge length shall be five times the diameter.

**prEN 13261:2023 (E)****4.2.2 Impact test characteristics****4.2.2.1 Values to be achieved**

Impact test characteristics shall be determined in the longitudinal and the transverse directions.

Values to be achieved at mid-radius of solid axles, or at mid-distance between external and internal surfaces of hollow axles, are given in Table 3.

Near the surface, the average value calculated from 3 specimens shall be greater than or equal to 0,95 times the average values measured at mid-radius or at mid-distance between external and internal surfaces of hollow axles.

In the centre of solid axles or near the internal surface of hollow axles, the average value calculated from 3 specimens shall be greater than 0,8 times the average values measured at mid-radius or at mid-distance between external and internal surfaces.

For forged axles, when defined in the technical specification, the sample may be taken from an axle journal extension as stated in Annex A.

No individual value shall be less than the minimum values defined in Table 3.

**Table 3 — Values to be achieved at mid-radius of solid axles or at mid-distance between external and internal surfaces of hollow axles**

<b>Grade</b>	<b>Average <i>KU</i> longitudinal (J)</b>	<b>Minimum <i>KU</i> longitudinal (J)</b>	<b>Average <i>KU</i> transverse (J)</b>	<b>Minimum <i>KU</i> transverse (J)</b>
EA1N	≥ 30	≥ 21	≥ 20	≥ 14
EA1T	≥ 40	≥ 28	≥ 25	≥ 18
EA4T	≥ 40	≥ 28	≥ 25	≥ 18

**4.2.2.2 Position of test pieces**

The test pieces shall be taken from three levels in the largest axle section:

- as near as possible to the external surface for all the axles;
- at mid-radius and in the centre of solid axles;
- at mid-distance between external and internal surfaces, and near the internal surface of hollow axles;

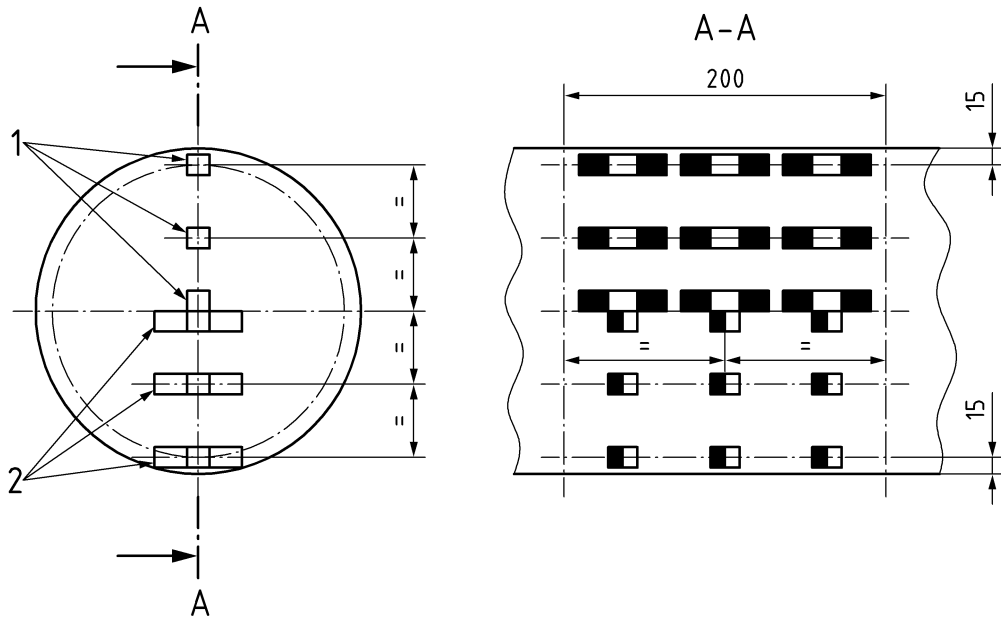
as shown in Figure 2a) and 2b).

For forged axles, when defined in the technical specification, a test piece may be taken from axle journal extensions as stated in Annex A.

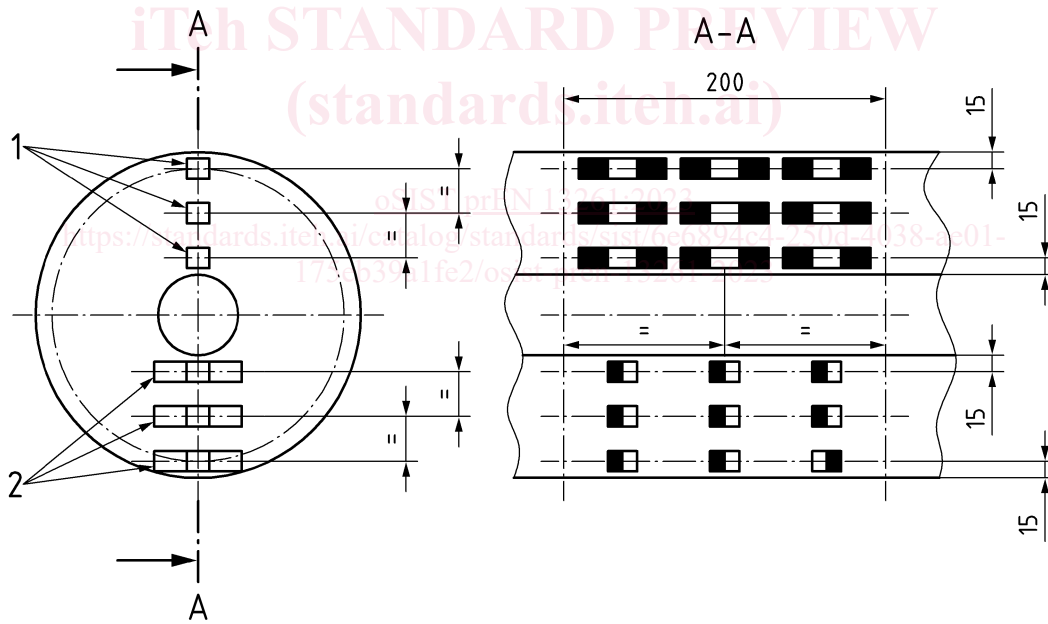
**4.2.2.3 Test method**

The test shall be carried out in accordance with EN ISO 148-1.

Dimensions in millimetres



a) Solid axle



b) Hollow axle

**Key**

- 1 longitudinal test piece
- 2 transverse test piece

**Figure 2 — Position of test pieces**