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Železniške naprave - Kolesne dvojice in podstavni vozički - Monoblok kolesa - Postopek za tehnično odobritev - 1. del: Kovana in valjana kolesa

Railway applications - Wheelsets and bogies - Monobloc Wheels - Technical approval procedure - Part 1: Forged and rolled wheels

Bahnanwendungen - Radsätze und Drehgestelle - Vollräder - Technische Zulassungsverfahren - Teil 1: Geschmiedete und gewalzte Räder

Applications ferroviaires - Essieux montés et bogies - Roues monobloc - Procédure d'homologation technique - Partie 1: Roues forgées et laminées

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Railway applications - Wheelsets and bogies - Monobloc Wheels - Technical approval procedure - Part 1: Forged and rolled wheels

Applications ferroviaires - Essieux montés et bogies -
Roues monobloc - Procédure d'homologation
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Vollräder - Technische Zulassungsverfahren - Teil 1:
Geschmiedete und gewalzte Räder

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European foreword

This document (EN 13979-1:2020) 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of an identical text or by endorsement, by January 2021 at the latest, and all conflicting national standards shall be withdrawn no later than January 2021.

Attention is drawn to the fact that some elements of this document may be the subject of patent rights or similar rights. CEN and/or CENELEC shall not be held responsible for identifying all or some of these patent rights.

This document replaces EN 13979-1:2003+A2:2011.

This document has been prepared in the context of a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For the relationship with Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are required to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, the Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, the Republic of Serbia, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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EN 13979-1:2020 (E)**Introduction**

An assessment of the two following aspects is carried out before a wheel is commissioned:

- assessment of the design as described in this standard;
- assessment of the quality of the product (EN 13262).

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1 Scope

The aim of this document is to define a design assessment procedure of a forged and rolled monobloc wheel (RST). This assessment is carried out before the wheel is commissioned. This document describes, in particular, the assessment to be performed in order to use wheels on a European network which, in addition, have quality requirements in conformity with those defined in EN 13262.

This assessment requires that the conditions of use for the wheel are defined and this standard provides a method for defining those conditions.

The assessment of the design covers four aspects:

- a geometrical aspect: to allow interchangeability of different solutions for the same application;
- a thermomechanical aspect: to manage wheel deformations and to ensure that braking will not cause wheels to fracture;
- a mechanical aspect: to ensure that no fatigue cracks occur in the wheel web and that no permanent deformation occurs under exceptional loading;
- an acoustic aspect: to ensure that the solution chosen is as good as the reference wheel.

This document does not cover assessment of the hub or of the rim.

This document has been drawn up for wheels of non-powered tread-braked wheelsets and applies in full to this type of wheel. For wheels on which disc brakes are mounted or toothed transmission wheels or even wheels with noise reduction devices, the requirements may be amended or supplemented.

For urban railway vehicles, other standards or documents may be used.

2 Normative references

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The following documents referred to in the text constitute, for all or part of their content, requirements of this document. For dated references, only the cited edition applies. For undated references, the last edition of the reference document applies (including any amendments).

EN 13103-1, *Railway applications — Wheelsets and bogies — Part 1: Design method for axles with external journals*

EN 13262:2004+A2:2011, *Railway applications – Wheelsets and bogies – Wheels – Product requirements*

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 at the following addresses:

- IEC Electropedia: <http://www.electropedia.org/>
- ISO Online browsing platform: <http://www.iso.org/obp>

EN 13979-1:2020 (E)**3.1****technical specification**

document describing specific parameters and/or design assessment procedure requirements as an addition to the requirements of this standard

3.2**diameter after last reprofiling**

nominal value defined by a 5 x 5 mm nominal chamfer and the slope of the new tread profile

Note 1 to clause: Adapted values can be defined, for example, in the maintenance plan or in the technical specification. See Figure C.1.

3.3**worn diameter**

theoretical minimum diameter in service, and cylindrical profile from the outer side of the rim to D_0 and then original new profile to the inner side of the rim

Note 1 to clause: See Figure C.1.

4 Parameters for the definition of the application covered**4.1 General**

The application for which a wheel is to be assessed shall be defined by the parameters set out below.

If the application parameters are changed for an assessed wheel, the assessment shall be reviewed.

4.2 Geometric parameters for interchangeability

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4.2.1 General

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The application shall be defined by geometric parameters for interchangeability, which can be split into three categories according to whether they are related to functional requirements, assembly requirements or maintenance requirements.

NOTE For rolling stock wheels that have to conform to the Directive, some of the geometrical parameters are given in the TSIs concerned.

4.2.2 Functional requirements

- the nominal tread diameter that influences the buffer height and the loading gauge;
- the maximum rim width linked to the switches and crossings and the track brakes;
- the tread profile outside the conical part of the tread;
- the position of the inner side of the rim relative to the corresponding side of the hub;
- the conicity of the hub bore;
- the space required for disc brakes mounted on the wheel;

- the space required on the bogie frame, braking equipment and suspension equipment.

4.2.3 Assembly requirements

- the bore diameter;
- the hub length to ensure the hub overhangs on the wheelseat.

4.2.4 Maintenance requirements

- the wear limit diameter or the last reprofiling diameter;
- the wear groove shape, if necessary;
- the geometry of the area for wheel clamping on reprofiling machines;
- the position and shape of the hole and groove for displacement under oil pressure;
- the general rim shape to allow ultrasonic measurement of residual stresses in tread-braked wheels.

4.3 Parameters for thermomechanical assessment of tread-braked wheels

4.3.1 Drag braking or consecutive stop braking

4.3.1.1 General

The application shall be defined based on the maximum braking energy (P_a nominal braking power, t_a application time (duration of the test) and V_a average speed of the vehicle) generated by the friction of the brake shoes on the tread, as well as the type of brake shoes applied to the wheel (the type – cast iron brake shoe or composite brake shoe – dimensions and number).

The braking test with composite brake shoes covers the braking test with cast iron brake shoes. The braking test with two opposing brake shoes covers the braking test with a single brake shoe. The braking test is independent of the manufacturing origin of the brake shoes.

4.3.1.2 freight rolling stock

When monobloc wheels are fitted to wagons that are 100% tread braked, the parameters in Table A.1 of Annex A shall apply, unless the technical specification defines them differently.

NOTE This table is the same as the table in the freight wagons TSI.

When a wagon is not 100% tread braked, nominal power, P_b , shall be adapted as defined in the technical specification.

For specific wagons or traffic, the power and/or application time and/or running speed values can be modified to check the thermomechanical behaviour of these wheels in the context of the requirements of the technical specification and in accordance with Table A.2 of Annex A.

EN 13979-1:2020 (E)**4.3.1.3 Other types of rolling stock**

Thermomechanical behaviour shall be verified for the worst braking case. This shall be done using drag braking in conformity with the parameters in Table A.2 of Annex A and/or the worst consecutive stop braking for this application.

This choice can be made taking into account the level of displacement and residual stresses calculated using numerical simulation for each of the braking scenarios considered.

The average slope and/or application time and/or average speed of consecutive stop braking and/or energy values shall be defined in the technical specification. Table A.2 of Annex A provides examples of values.

NOTE The values of the Loc & Pas TSI clause 4.2.4.5.4 are valid for the assessment of the braking system, not for the wheel.

4.3.2 Accidental drag braking incident**4.3.2.1 General**

The thermomechanical behaviour shall be defined based on the maximum braking energy (P_a braking power, t_a application time (duration of the test) and V_a average speed of the vehicle) generated by the friction of the brake shoes on the tread that the wheel to be assessed must be able to dispel when there is an accidental drag braking incident.

4.3.2.2 100% tread-braked wheels

For freight wagons, the parameters for the accidental drag braking incident are identical to those defined for drag braking (see Table A.1 of Annex A).

For other types of rolling stock, the parameters for the accidental drag braking incident are identical to those of drag braking (see Table A.2 of Annex A) for 100% tread braking.

4.3.2.3 Non-tread-braked wheels

For all types of rolling stock, the parameters for the drag braking incident shall be:

- a) Parameters for the accidental drag braking incident test for a 100% tread-braked wheel (see subclause 4.3.2.2);
- b) Or the parameters for the wheel fracture bench test (see subclause 7.3)

4.4 Mechanical assessment parameters

The application shall be defined by:

- the maximum vertical static force per wheelset (according to EN 13103-1);
- the type of route to be provided by the vehicles that will be fitted with the wheels to be assessed:
 1. description of the lines: geometric quality of the tracks, curve parameters, maximum speeds, etc. ;
 2. running times on these lines;
- the estimated service life of the wheel, in kilometres.

In the case of a mechanical assessment solely by means of calculation, the parameters of subclause 8.2 shall be taken into consideration.

4.5 Acoustic assessment parameters

The application shall be defined by all the parameters influencing the noise emitted by the wheel and not directly involved in the design of the wheel to be assessed, such as:

- 1) the reference track on which the wheel shall run;
- 2) the reference wheel to which the design will be compared;
- 3) the reference rolling stock and one or more reference speeds;
- 4) a surface roughness spectrum, representative of the operational tread condition (cast iron or composite tread braked or not tread braked) of the wheel under test, to be used on both the reference wheel and the new wheel.

5 Description of the wheel, the design of which shall be assessed

The assessment documentation of the design of the wheel shall include:

1. the description of the manufacturing process (forging, rolling, heat treatment, etc.);
2. the definition of the wheel geometry (drawing);
3. the following manufacturing parameters, if they differ from those defined in EN 13262:
 - geometric tolerances;
 - surface finishes, [SIST EN 13979-1:2020](https://standards.iteh.ai/catalog/standards/sist/c6efa856-7daa-49e8-b31f-a84fb77fc027/sist-en-13979-1-2020)
 - steel grade;
4. the parameters for defining the application for which the design assessment is requested.

6 Assessment of geometric interchangeability

The wheel design shall conform to the requirements of subclause 4.2.

7 Assessment of thermomechanical behaviour

7.1 General procedure

This assessment comprises of three stages. The transition from one stage to the next depends on the results obtained.

The flowchart for this assessment is shown in Annexe B (normative).

For each of the three stages, the tests shall be carried out on a new rim (nominal diameter) and at a diameter after last reprofiling (see Annexe C).

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7.2 First stage – Braking bench test

7.2.1 Test procedure

The test method and the measurements to be taken are given in normative Annex B.

For freight wagons the requirements in subclause 4.3.1.2 shall apply. For other vehicles, the power to be applied during this test shall be equal to $1.2 P_a$ (P_a is defined in 4.3). The duration of each drag braking period and the average train speed are those defined in 4.3 and in Annexes A and B (t_a and V_a).

7.2.2 Decision criteria

Three criteria shall be met simultaneously for the wheel with the new rim and the wheel diameter after last reprofiling.

a) Wheel with new rim:

- 1) maximum lateral displacement of the rim while hot during braking: $+ 3/- 1$ mm;
- 2) level of residual stress in the rim after cooling:

- i) $\sigma_{rn} \leq + \Sigma_r \text{ N/mm}^2$ as the average of three measurements;

- ii) $\sigma_{in} \leq + (\Sigma_r + 50) \text{ N/mm}^2$ for each of the measures;

- 3) maximum lateral displacement of the rim while cold: $+ 1.5/- 0.5$ mm.

b) Wheel at a diameter after last reprofiling:

- 1) maximum lateral displacement of the rim while hot during braking: $+ 3/- 1$ mm;
level of residual stress in the rim after cooling:

- i) $\sigma_{rw} \leq + (\Sigma_r + 75) \text{ N/mm}^2$ for the average of the three measures;

- ii) $\sigma_{iw} \leq + (\Sigma_r + 100) \text{ N/mm}^2$ for each of the measures;

- 2) maximum lateral displacement of the rim while cold: $+ 1.5/- 0.5$ mm.

The value of Σ_r shall be defined according to the criteria of the steel grades of the wheel rim. For grades ER6 and ER7 of EN 13262, $\Sigma_r = 200 \text{ N/mm}^2$.

Displacement is positive when it corresponds to a wide gauge of the internal faces of the two wheels of the wheelset.

For wheels on rolling stock that do not have to satisfy the requirements of the Interoperability Directive, if the track tolerances differ from the general tolerances used in Europe, other values of displacement may be defined in the technical specification.

7.3 Second stage – Wheel fracture bench test

7.3.1 General

This second stage shall be proceeded with if the residual stress levels measured during the first stage exceed the decision criteria, or in application of subclause 4.3.2.3.

7.3.2 Test procedure

The test procedure is given in Annex B (normative).

7.3.3 Decision criterion

The wheels must not fracture during the test.

7.4 Third stage – Field braking test

7.4.1 General

This third stage shall be proceeded with if one of the results of the first stage does not respect the decision criteria and if the wheel is not rejected after stage two.

7.4.2 Test procedure

The test method and the measurements to be taken are given in Annex B (normative).

The power to be taken into account for these tests is $1,2 P_a$ (P_a is defined in 4.3). The duration of each drag braking and the average running speed of the vehicle are those defined in 4.3 (t_a and V_a).

7.4.3 Decision criteria

Three criteria shall be met simultaneously for the wheel with the new rim and the wheel at a diameter after last reprofiling: <https://standards.iteh.ai/catalog/standards/sist/c6efa856-7daa-49e8-b31f-a84fb77fc027/sist-en-13979-1-2020>

a) Wheel with new rim:

- 1) maximum lateral displacement of the rim while hot during braking: + 3/- 1 mm;
level of residual stress in the rim after the tests and after cooling:
 - i) $\sigma_{rn} \leq + (\Sigma_r - 50) \text{ N/mm}^2$ for the average of the three measures;
 - ii) $\sigma_{in} \leq + \Sigma_r \text{ N/mm}^2$ for each of the measures;
- 2) maximum lateral displacement of the rim while cold after the tests: + 1,5/- 0,5 mm.

b) Wheel at a diameter after last reprofiling:

- 1) maximum lateral displacement of the rim while hot during braking: + 3/- 1 mm;
level of residual stress in the rim after the tests and after cooling:
 - i) $\sigma_{rw} \leq + \Sigma_r \text{ N/mm}^2$ for the average of the three measures;
 - ii) $\sigma_{iw} \leq + (\Sigma_r + 50) \text{ N/mm}^2$ for each of the measures;
- 2) maximum lateral displacement of the rim while cold after the tests: + 1,5/- 0,5 mm.