SLOVENSKI STANDARD
SIST EN 12082:2017+A1:2021

01-september-2021

Železniške naprave - Ohišja ležajev kolesnih dvojic - Preskušanje delovanja

Railway applications - Axleboxes - Performance testing

Bahnanwendungen - Radsatzlager - Prüfung des Leistungsvermögens

Applications ferroviaires - Boïtes d'essieux - Essais de performance

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Ta slovenski standard je istoveten z: **EN 12082:2017+A1:2021**

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ICS:

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

SIST EN 12082:2017+A1:2021 **en,fr,de**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12082:2017+A1

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English Version

Railway applications - Axleboxes - Performance testing

Applications ferroviaires - Boîtes d'essieux - Essais de performance

Bahnanwendungen - Radsatzlager - Prüfung des Leistungsvermögens

This European Standard was approved by CEN on 19 June 2017 and includes Amendment 1 approved by CEN on 2 May 2021.

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European foreword

This document (EN 12082:2017+A1:2021) 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of an identical text or by endorsement, at the latest by December 2021, and conflicting national standards shall be withdrawn at the latest by December 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes A1 EN 12082:2017 A1.

A1 The main changes with respect to the previous edition are listed below:

— A clarification on how to account for stops and variations in speed is added

— A clarification on how to evaluate the first four elementary trips as well as the pre-test is added

— A clarification on which type of axlebox to be tested in the field is added

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— The location of the temperature sensor position in the target zone is better specified

— The temperature criteria are clarified and Annex D (informative) gives examples on evaluation

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— Formula A.4 in A.9.2 “Preconditions for applicability of existing results” is corrected

— Annex ZA is removed since it is not relevant for this norm being a testing standard

NOTE Clause 6 of the previous version of the EN (EN 12082:2007+A1:2010) is referred to in both TSI's on rolling stock and remains mandatory. Clause 7 of this version of the EN is an improvement of the Clause 6 of the previous version and is therefore equivalent. A1

This document includes Amendment 1 approved by CEN on 11 April 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

A1 *deleted text* A1

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

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Introduction

To improve the reliability, availability, durability, the high speed capacity and maintenance of the European rail transportation system, there is a need to ensure the required quality, safety and efficiency of axleboxes that are covered by the set of standards: EN 12080, EN 12081 and EN 12082.

This European Standard has been drawn up with the purpose of standardizing the performance testing of axleboxes for all types of rolling stock to ensure suitability for the required service, i.e. that the assembly of box housing, bearing(s), seal(s) and grease is well suited for the service requirements.

This testing is made in two stages, a “rig test”, described in detail in this European Standard, and a “field test”. The extent of testing to be applied depends on the novelty of bearing design, seal design, grease formulation and/or box housing, as well as the application (see EN 12080 and EN 12081).

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1 Scope

This European Standard specifies the principles and methods for a rig performance test of the system of axlebox rolling bearing(s), housing, seal(s) and grease. Test parameters and minimum performance requirements for vehicles in operation on main lines are specified. Different test parameters and performance requirements may be selected for vehicles in operation on other networks (e.g. urban rail). This standard is historically developed for outboard applications but can be used for vehicles with other bearing arrangements (e.g.: inboard application or single wheels).

It gives some possible examples where a "sequenced performance test" addresses the broad range of different service conditions within a specific application or vehicle platform into account.

It describes in detail the water tightness test and basic principles and minimum requirements for a field test.

This European Standard only applies to axleboxes equipped with rolling bearings and greases according to EN 12080 and EN 12081.

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.

ASTM D7303:2012, *Standard Test Method for Determination of Metals in Lubricating Greases by Inductively Coupled Plasma Atomic Emission Spectrometry*

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DIN 51460-1:2007, *Testing of petroleum products - Method for sample preparation - Part 1: Microwave incineration*

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DIN 51829:2013, *Petroleum products - Determination of additive and wear elements in greases - Analysis by wavelength dispersive X-ray fluorescence spectrometry*

EN 12080:2017, *Railway applications - Axleboxes - Rolling bearings*

〚A1〛 EN 12081 〈A1〉, *Railway applications - Axleboxes - Lubricating greases*

〚A1〛 EN 15663 〈A1〉, *Railway applications - Definition of vehicle reference masses*

〚A1〛 EN ISO 11885 〈A1〉, *Water quality - Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007)*

ISO 15243:2017, *Rolling bearings — Damage and failures — Terms, characteristics and causes*

3 Terms and definitions

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

3.1
axlebox
assembly consisting of the following major components: rolling bearing(s), grease, seal(s) and box housing

Note 1 to entry: Further components such as axle end cap components, bearing sleeve, box cover(s), distance rings, fasteners, labyrinth(s) may be also part of the assembly but their presence depends on the axlebox type design.

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3.2
box housing
structural component which contains rolling bearing(s), seal(s) and grease

3.3
ovality
change (permanent deformation) in the bore's shape of an axlebox housing becoming slightly oval

3.4
rolling bearing
bearing operating with rolling motion between the parts, supporting load and moving in relation to each other

3.5
cartridge bearing
rolling bearing with two or more rows of rolling elements within a self-contained unit, greased and equipped with integral seals

3.6
grease
semi-solid lubricant, which consists of a thickener and additives dispersed in lubricating oil

3.7
seal
component that protects the rolling bearing(s) against ingress of water and dust and retains grease in the rolling bearing(s)

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3.8
roller set
assembly of cage and rollers

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3.9.1
inboard
〉A1〈 with reference to an axlebox with more than one bearing row 〉A1〈 designates the bearing row closer to the middle of the wheelset or the test rig

3.9.2
inboard
with reference to the vehicle or application, designates a configuration with rolling bearings that are positioned on a wheelset axle between the wheels of a wheelset

3.10.1
outboard
with reference to an axlebox with more than one bearing row, designates the bearing row that is next to the inboard bearing row to the outside direction

3.10.2
outboard
with reference to the vehicle or application, designates a configuration with rolling bearings that are positioned on wheelset axle ends, outside of the space between the wheels of a wheelset

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3.11
maximum operational test speed
v_{max}
maximum operational speed for normal service (in km/h) for which the vehicle shall be homologated

3.12
nominal rotational test speed
n_{test}
rotational speed (using the half worn wheel diameter) corresponding to V_{max} increased by 10 % (in rpm)

3.13
target zone
defined area on the underside of an axlebox that is designed to have its temperature monitored by a hot axlebox detector (HABD)

3.14
main line
railway network open to different types of rolling stock

3.15
urban rail
public transport systems permanently guided at least by one rail, intended for the operation of local, urban and suburban passenger services with self-propelled vehicles and operated either segregated or not from general road and pedestrian traffic

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[SOURCE: CEN-CENELEC Guide 26]

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3.16
network
infrastructure, on which any railway undertaking can operate rolling stock

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in Tables 1 and 2 apply.

Table 1 — Symbols

Symbol	Unit	Description
$d_{average}$	m	average wheel diameter between new and fully worn condition
d_{max}	m	wheel diameter in new condition
d_{min}	m	wheel diameter at limit of wear condition
D_{max_n}	m	maximum bore diameter under loaded condition of the new housing
D_{min_n}	m	minimum bore diameter under loaded condition of the new housing
D_{max_r}	m	maximum bore diameter under loaded condition of the reference housing
D_{min_r}	m	minimum bore diameter under loaded condition of the reference housing

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Symbol	Unit	Description
F	N	force
F_0	N	reference vertical force applied per wheelset on the track
F_a	N	axial test force
F_{an}	N	nominal axial test force
F_r	N	radial test force
F_{rn}	N	nominal radial test force
g	m/s²	acceleration due to gravity (9,81 m/s²)
j	-	number of wheelsets per vehicle
m_2	kg	wheelset mass and masses on the wheelset between rolling circles, like brake disc, etc.
m_{max}	kg	vehicle design mass according to EN 15663
n	rpm	rotational test speed corresponding to v
n_{test}	rpm	[A1] (see 3.12 nominal rotational test speed definition) [A1]
[A1] N_{trips}	-	estimated number of elementary trips needed to achieve the performance test (based on nominal speed) [A1]
[A1] N_{trips_adj}	-	adjusted value of N_{trips} to account for interruptions and variations in speed [A1]
t_1	s	time of one test cycle (see A.6)
t_2	s	time of one elementary trip
t_3	s	ramp up or ramp down time from $n = 0 \rightarrow n = n_{test}$ or $n = n_{test} \rightarrow n = 0$ during one elementary trip
t_4	s	time at rotational speed n_{test} during one elementary trip
t_5	s	stop time ($n = 0$)
t_6	s	time of one half load cycle of the alternating axial test force
t_7	s	time during which axial test force is applied (including ramp up and ramp down) within the period t_6
t_8	s	ramp up or ramp down time from $F_a = 0 \rightarrow F_a = F_{an}$ or $F_a = F_{an} \rightarrow F_a = 0$ during one half load cycle of the alternating axial test force
t_9	s	axial test force recovery time
T_a	°C	[A1] ambient temperature (it is permitted to use a running average value for 30 min maximum to compensate for rapid changes in the ambient temperature) [A1]
T_{z20}	°C	[A1] measured temperature at a position z and then re-calculated to a temperature corresponding to an ambient temperature of 20 °C [A1]
T_{zm}	°C	measured temperature at a position z (measured

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Symbol	Unit	Description
		positions are loading zones and target zones)
v	km/h	speed of the vehicle
v_{max}	km/h	A1 (see 3.11 maximum operational test speed definition) A1

Table 2 — Abbreviations

Abbreviation	Description
HABD	hot axlebox detector
ICP	inductively coupled plasma (spectrometry)
MEP	mounted end play
XRF	X-ray fluorescence (spectrometry)

5 Test specification

5.1 General requirements

The test specification shall consist of all the information describing test parameters and acceptance criteria. It includes the inputs of the rig performance test, the optional water tightness test and the field test.

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The following information shall be fully documented in the test specification and shall be part of the approval process. The requirements as specified in this European Standard shall be satisfied before a claim of compliance with this European Standard can be made and verified.

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5.2 Test specification content

5.2.1 General

The following requirements which are specified in the clauses referred to shall at least be fully documented and included in the test specification.

5.2.2 Rig tests

a) Performance test:

- performance test report recipients list;
- quality management system accreditation and its scope;
- interface drawing showing mounting conditions of all components as in-service;
- boundary dimensions and interface tolerances of the rolling bearing(s);
- MEP requirements;
- conditions of production of the bearings (serial production, prototype);
- grease (according to EN 12081) designation, quantity and distribution, batch reference and production date;
- specification of the test parameters according to 7.2.2;

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- deviations to the test parameters in A.4 and A.6;
- approval procedure type with regard to Clause 14 and Annex E of EN 12080:2017 as well as A.9 of this standard;
- required test distance;
- deviations to the performance test report according to 7.5;
- possible extrapolation of the physico-chemical criteria according to A.8.2.

b) Water tightness test (optional):

- water tightness report recipients list;
- requirement of a water tightness test according to Annex C;
- quality management system accreditation and its scope;
- interface drawing showing mounting conditions of all components as in-service;
- conditions of production of the bearings (serial production, prototype);
- specification of the test parameters according to C.3.

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5.2.3 Field test

- field test report recipients list;

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- reference to the linked performance test report or proven design application;
- specification of the test parameters according to 8.3;
- required test distance;
- annual specified distance travelled of the intended service;
- minimum quantity of axleboxes to be monitored;
- duration (in terms of time or distance travelled) of each intermediate inspection interval;
- scope of monitoring and inspections activities;
- values for iron content and copper content if a grease analysis is specified and if not, for information only.

6 Water tightness test

The test specification shall specify whether a water tightness test shall be made.

This test shall be performed as described in Annex C.

In case of a new seal, a water tightness test should be performed.

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7 Rig performance test

7.1 General

The purpose of the rig performance test is to check the satisfactory design and safe function of the axlebox during a sequence of simulated journeys.

Rig performance test and mandatory grease analyses shall be performed by a competent test facility.

NOTE Competence of a test facility is usually proven by accreditation to EN ISO/IEC 17025.

The test consists of putting a pair of axleboxes, assembled as for operating conditions, on the test rig journals and subjecting them to one or more sequence(s) of repeated loading cycles determined from the test specification (based on the operating conditions of the vehicles to be equipped with these axleboxes, if available).

The bearings shall be mounted in such a way that the maximum difference in mounted clearance is achieved with the selected bearings and available equipment. The mounted end plays (MEP) according to the bearing specification shall be calculated taking into account: measured bearing un-mounted clearance, measured journal diameters, measured bearing bore diameters, inner and outer raceways angles (at the rolling element contact points), inner and outer raceways mean diameter.

The MEP shall be measured before and after the performance test (axial play for tapered bearings and radial play for cylindrical or spherical bearings).

If the identical rolling bearing(s), seal(s) and grease have already successfully been tested, A.9 gives guidance under which conditions the already passed test can be accepted for the intended application.

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During rig operation (during a sequence), the axleboxes are subjected to constant radial force and alternated axial force.

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Before the performance test, a pre-test shall be carried out. This does not constitute part of the evaluated approval test for the bearings or grease being tested. It is intended to observe the thermal behaviour of the axleboxes during the grease migration at the beginning of the rig test.

The performance test consists of repeating identical cycles up to an agreed cumulative distance. The number of cycles and the required test distance reflect the service conditions of the intended application. ⟨A1⟩ Throughout the test, the performance of the axleboxes shall be monitored by measurement of temperatures ⟨A1⟩, the values of which, both absolute and relative, shall remain within limits. Finally, on completion of the test, the bearings and the grease shall be inspected and shall not show any changes beyond limits imposed.

7.2 Test execution

7.2.1 Test rig

The test rig shall apply testing conditions which are derived from the service operating conditions and ensure accurate monitoring of the axleboxes under test. The influence of the rig on the tested axleboxes shall be minimized. Especially, the avoidance of the transfer of disturbances from one axlebox to the other one.

The test rig shall at least include:

a) one axle or two synchronized axles, on which the axleboxes are mounted on the journals;

b) rotation mechanism to apply the nominal test speed n_{test};

c) device for measuring the rotational speed of the axle n;

d) device arranged to subject each axlebox to a radial force $F_r = F_{rn}$;

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e) measuring device to monitor this radial test force F_r;

f) device arranged to subject each axlebox to an alternating axial force F_a;

g) measuring device to monitor this alternating axial test force F_a;

h) ventilation equipment to simulate the cooling in operation;

i) sensors permitting temperature measurement:

1) by one sensor in the loaded zone of each rolling bearing row, aligned centrally above the bearing rows and in contact with the outer ring, with typical positions shown in Figure A.3 (for an axlebox with two bearings);

2) in the target zone of the hot axlebox detectors (HABD), by one sensor in direct contact with the surface of the axlebox housing as indicated in Figure A.3 (a non-contacting temperature sensor –measuring in the same zone – shall be used only in case there are no suitable surfaces to attach a sensor);

3) of the ambient air stream which is directed at each axlebox, measured at the outlet of the cooling fans (see Figure A.1). For ducted air streams the sensors have to be positioned adequately in the air flow upstream of each axlebox (see Figure A.2).

Examples of test rigs are shown in A.1.

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7.2.2 Test parameters

7.2.2.1 General

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The test parameters shall be defined on the basis of the operating conditions of the vehicles to be equipped with the axleboxes and documented in accordance with the test specification in Clause 5. The following information is required, agreed and documented in the test specification before the test and presented in the test report:

a) design mass according to EN 15663: m_{max}, (in kg) is:

1) the “design mass under normal payload” (see EN 15663) when considering passenger vehicles (including High Speed Trains) or freight vehicles;

2) the “design mass in working order” when considering locomotives. Locomotives are treated as passenger vehicles without payload.

b) mass not carried by the bearings: m_2 (wheelset mass and masses on the wheelset between wheel rolling circles, like brake disc, etc.), in kg;

c) axial test force recovery time: t_9, in s;

d) wheel diameter new: d_{max} and at the limit of wear: d_{min}, in m;

e) maximum operational speed: v_{max}, in km/h;

f) pre-test procedure;

g) required test distance, in km.