



BSI Standards Publication

Railway applications — Axleboxes

Part 1: Test procedures

National foreword

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European foreword

This document (EN 12082-1:2025) 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of an identical text or by endorsement, at the latest by June 2026, and conflicting national standards shall be withdrawn at the latest by May 2026.

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

This document supersedes EN 12082:2017+A1:2021.

EN 12082-1:2025 includes the following significant technical changes with respect to EN 12082:2017+A1:2021:

- document split into EN 12082-1 on Test procedures and EN 12082-2 on Deployment procedure;
- EN 12082-1 contains requirements for tests which are referred to in EN 12082-2 as part of the axlebox deployment procedure. These test requirements focus on test preparation, test execution and post-test actions including the test report. Main addressees of EN 12082-1 are testing institutes which carry out the tests;
- requirements on test specifications and test reports are revised and separated for each test;
- tightness tests are now mentioned with water tightness test as one example;
- modified requirements on water tightness test with respect to test procedure and test conditions;
- modifications to rig performance test with respect to results obtained after the test, definition of grease sampling areas, test report and test procedure;
- modifications to field test requirements with respect to acceptance criteria.

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

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1 Scope

This document is a part of a package of standards: EN 12080, EN 12081, EN 12082-1 and EN 12082-2.

This document specifies the principles and methods for a rig performance test of the system of axlebox rolling bearing(s), housing, seal(s) and grease, required for reliable operation of trains on European networks. The necessary type and extent of testing are specified by the deployment procedure specified in EN 12082-2, with respect to design requirements on the axlebox and its components.

This document covers a rig performance test, principles for a field test and a possible example for a water tightness test. 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 document is historically developed for outboard applications with rotating inner rings, but can be used for vehicles with inboard bearing arrangements with rotating inner rings.

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

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.

ASTM D7303:2023, *Standard Test Method for Determination of Metals in Lubricating Greases by Inductively Coupled Plasma Atomic Emission Spectrometry*

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

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

EN 12081:2025, *Railway applications — Axleboxes — Lubricating greases*

EN 12082-2:2025, *Railway applications — Axleboxes — Part 2: Deployment Procedure*

EN 15663, *Railway applications — Definition of vehicle reference masses*

EN ISO 11885:2009, *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.

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

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 may also be part of the assembly but their presence depends on the axlebox type design and they are not considered major components.

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 a box 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)

3.8

roller set

assembly of cage and rollers

3.9

inboard bearing

<axlebox with more than one bearing row> designates the bearing row closer to the middle of the wheelset or the test rig

3.10**inboard application**

<vehicle or application> configuration with rolling bearings that are positioned on a wheelset axle between the wheels of a wheelset

3.11**outboard bearing**

<axlebox with more than one bearing row> bearing row that is next to the inboard bearing row to the outside direction

3.12**outboard application**

<vehicle or application> configuration with rolling bearings that are positioned on wheelset axle ends, outside of the space between the wheels of a wheelset

3.13**maximum operational test speed**

$v_{\max}$

maximum operational speed for normal service (in km/h) for which the vehicle is homologated

3.14**nominal maximum rotational test speed**

n_{test}

rotational speed (using the average wheel diameter) corresponding to $v_{\max}$ increased by 10 % (in rpm)

3.15**target zone**

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

3.16**main line**

railway network open to different types of rolling stock

3.17**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

[SOURCE: CEN-CENELEC Guide 26:2013, Clause 1]

3.18**network**

infrastructure, on which any railway undertaking can operate rolling stock

3.19**deployment process**

methodical procedure of introducing an axlebox or a change to an axlebox into vehicle service

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in Table 1 and Table 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
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/s ²	acceleration due to gravity (9,81 m/s ²)
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	nominal maximum rotational test speed (see 3.14)
N_{trips}	-	estimated number of elementary trips needed to achieve the performance test (based on nominal speed)"
$N_{\text{trips_adj}}$	-	adjusted value of N_{trips} to account for variations in speed"
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 $n = 0 \rightarrow n = n_{\text{test}}$ OR $n = n_{\text{test}} \rightarrow n = 0$ 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 $F_a = 0 \rightarrow F_a = F_{\text{an}}$ OR $F_a = F_{\text{an}} \rightarrow F_a = 0$ during one half load cycle of the alternating axial test force
t_9	s	axial test force recovery time

Symbol	Unit	Description
T_a	°C	ambient temperature (A running average can be used for this value. If a running average is used, the duration for the running average shall be justified and documented)
T_{z20}	°C	measured temperature at a position z and then re-calculated to a temperature corresponding to an ambient temperature of 20 °C
T_{zm}	°C	measured temperature at a position z (measured positions are loading zones and target zones)
v_{max}	km/h	maximum operational test speed (see 3.13)

Table 2 — Abbreviations

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

5 Water tightness test

5.1 General

The necessity for a tightness test is subject to the specification of the deployment process. An example for a water tightness test is given in Annex C.

5.2 Test specification

The test specification shall consist of all the information describing test parameters and acceptance criteria.

The following requirements shall at least be fully documented and included in the test specification:

- report recipients list
- 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.

6 Rig performance test

6.1 General

The purpose of the rig performance test is to check the satisfactory design and safe function of the axlebox major components 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 by the laboratory customer 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).

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

Before the performance test, a pre-test shall be carried out. This does not constitute part of the evaluated performance test. 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. Throughout the test, the performance of the axleboxes shall be monitored by measurement of temperatures, 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.

6.2 Test specification

The test specification shall consist of all the information describing test parameters and acceptance criteria.

The following requirements shall at least be fully documented and included in the test specification:

- a) report recipients list;
- b) quality management system accreditation and its scope;
- c) interface drawing showing mounting conditions of all components as in-service;
- d) boundary dimensions and interface tolerances of the rolling bearing(s);
- e) MEP requirements;
- f) conditions of production of the bearings (serial production, prototype);
- g) grease (according to EN 12081:2025) designation, quantity and distribution, batch reference and production date;
- h) specification of the test parameters according to 6.3.2;
- i) deviations to the test parameters in A.4 and A.6;
- j) required test distance;
- k) deviations to the performance test report according to 6.6;

- l) possible extrapolation of the physico-chemical criteria according to A.8.2.
- m) Type of vehicle (see Table A.1)

6.3 Test execution

6.3.1 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 $F_r = F_{rn}$;
- 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.

6.3.2 Test parameters

6.3.2.1 General

The test parameters shall be specified 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 6.2. 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.

If not calculated according to A.4, the test forces: F_{an} and F_{rn} (in N) have to be specified in the test specification according to 6.2.

Deviations from the test parameters in A.4 and A.6 (pre-test shall not be considered) are allowed, based on test specifications 6.2. Those deviations shall be indicated in the test report.

6.3.2.2 Rotational test speed

The maximum rotational test speed n_{test} (in rpm), maintained most of the time during the test, is that of a wheelset on which the wheels are half worn and where the rotational speed is equal to the maximum operational vehicle speed $v_{\max}$, increased with a safety margin of 10 %.

$$n_{\text{test}} = \frac{110 \times v_{\max}}{6 \times \pi \times d_{\text{average}}} \quad (1)$$

where

$$d_{\text{average}} = (d_{\min} + d_{\max}) / 2$$

The tolerances are specified in A.6.

Since the speed may vary within tolerances specified in A.6 the number of elementary trips N_{trips} need to be adjusted to $N_{\text{trips_adj}}$ to evaluate the acceptance criteria in A.7.

Test carried out with a n_{test} rotation speed calculated from the worn wheel diameter $d_{\min}$ should be considered acceptable if this complies with the test specification 6.2.

6.3.2.3 Radial and axial forces

The test forces are applied to each axlebox inducing forces on the rolling bearings, simulating as closely as possible the distribution of forces from the primary suspension. There shall be a constant radial force and an alternating axial force. The axial force shall be aligned with the axis of the axle.

The methods to define the nominal radial test force F_{rn} and the nominal axial test force F_{an} are specified in A.4 based on the load data specified in accordance with 6.2. The forces are calculated for one axlebox.

The axial force shall not be applied when the test speed n is less than 20 % of the nominal test speed n_{test} .