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Železniške naprave - Ohišja ležajev kolesnih dvojic - Preskus delovanja

Railway applications - Axleboxes - Performance testing

Bahnanwendungen - Radsatzlager - Prüfung des Leistungsvermögens

Applications ferroviaires - Boîtes d'essieux - Essais de performances

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English Version

Railway applications - Axleboxes - Performance testing

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This European Standard was approved by CEN on 8 November 2007.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 12082:2007) 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of an identical text or by endorsement, at the latest by June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

This document supersedes EN 12082:1998.

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to support Essential Requirements of EU Directive 96/48¹⁾ and EU Directive 2001/16²⁾, as modified by EU Directive 2004/50³⁾ of 29 April 2004.

For relationship with EU Directives, see informative Annexes ZA and ZB, which are an integral part of this document.

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

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¹⁾ Official Journal of the European Communities No. L 235 of 17.9.96.

²⁾ Official Journal of the European Communities No. L 110 of 20.4.01.

³⁾ Official Journal of the European Communities No. L 220 of 21.6.04.

Introduction

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, sealing and grease is well suited for the service requirements.

This testing is made up of two stages, a "rig performance test", described in detail in this European Standard, and a "field test". When rig performance testing is specified, it needs to be carried out in accordance with this European Standard. The extent of testing to be applied depends on the novelty of bearing design, seal design, grease formulation or box housing, as well as the application (see EN 12080 and EN 12081).

The rig performance test will check the satisfactory function of the assembly during a simulated journey. It is to be applied only if the axlebox is composed of elements delivered by suppliers that operate a quality management system⁴⁾.

The field test comprises monitoring on vehicles in service of a sufficiently large sample of axleboxes during a high mileage.

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⁴⁾ The systems used should offer equivalence with EN ISO 9001.

1 Scope

This European Standard specifies the principles and methods for a rig performance test of the system of box housing, rolling bearings, sealing and grease. Test parameters and minimum performance requirements for vehicles in operation on main lines are specified in Clause 6 and Annex A (normative). Different test parameters and performance requirements may be selected for vehicles in operation on other networks.

Basic principles for a field test are also determined.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12080, *Railway applications — Axleboxes — Rolling bearings*

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

ISO 2137, *Petroleum products — Lubricating grease and petrolatum — Determination of cone penetration*

ISO 2176, *Petroleum products — Lubricating grease — Determination of dropping point*

ISO 3733, *Petroleum products and bituminous materials — Determination of water — Distillation method*

NF F 19-503⁵⁾, *Matériel roulant ferroviaire — Méthode d'essais des graisses pour boîtes d'essieux à roulements — Essai dynamique de la stabilité à l'oxydation des graisses*

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3 Terms and definitions

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

3.1

customer

railway undertaking, manufacturer or buyer of railway rolling stock or subassemblies, or their representative

3.2

railway undertaking

organisation or its representative, whatever status it has, which is responsible for the registration of rolling stock

3.3

supplier

supplier of rolling bearings, sealing, grease or box housings for axleboxes, manufactured under his responsibility

3.4

axlebox

assembly of box housing, rolling bearings, sealing and grease

⁵⁾ NF — Association Française de Normalisation (AFNOR), 11 avenue Francis de Pressensé, 93571 La Plaine Saint-Denis Cedex, Tel.: +33 (0) 1 41 62 80 00, Fax: +33 (0) 1 49 17 90 00.

3.5

box housing

structural component which contains rolling bearings, sealing and grease

3.6

rolling bearing

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

3.7

cartridge bearing

rolling bearing with two or more rows of rolling elements within a single outer ring, greased and equipped with integral seals

3.8

grease

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

3.9

sealing

component that protects the rolling bearings against ingress of water and dust and retains grease in the rolling bearings

3.10

nominal test speed

vehicle speed limit increased with 10 %

3.11

main line

railway network open to different types of rolling stock

3.12

network

infrastructure, on which any railway undertaking can operate rolling stock

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4 Information and conditions to be agreed and documented

The approval procedures for the rolling bearings are defined in EN 12080 and for the lubricating greases in EN 12081. The rig performance test is stipulated in both of these European Standards. For the rig performance test, the following is to be agreed between the customer and the supplier and shall be fully documented by the supplier:

- designation and characteristics of the rolling bearing according to EN 12080;
- designation and characteristics of the lubricating grease according to EN 12081;
- designation and characteristics of the sealing;
- designation and characteristics of the box housing;
- input data required for determining test parameters are further described in 6.2.2;
- extent of testing for rolling bearings for vehicles not in operation on main lines;
- extent of testing for rolling bearing, grease, sealing or box housing similar to service proven designs (see A.5);
- conditions intended for the field test (see Clause 7).

5 Watertightness test

The customer shall specify whether a watertightness test shall be made.

A suitable method (in static mode) is presented in A.9.

A method for optional further dynamic testing is described in UIC 515-5.

6 Rig performance test

6.1 General

The test consists of putting two axleboxes on a test rig and subjecting them to repeated loading cycles determined from the operating conditions of the vehicles to be equipped with these axleboxes.

Two identical axleboxes including; rolling bearings, sealing, grease and box housing, assembled as for operating conditions shall be mounted on the test rig axle journals. After mounting, the clearance shall be as close as possible to the maximum of the tolerance for one axlebox and minimum for the other.

During rig operation, the axleboxes are subjected to constant vertical loads and varying transversal loads which will produce radial and axial forces on the rolling bearings.

Calculating the constant nominal radial force F_{rn} and the nominal axial load F_{an} is carried out by means of the methods described in A.4. The constant radial load is designated F_r , and the varying actual axial load is designated F_a . All these forces are applied on one journal with axlebox.

Other test parameters including different radial and axial load cycles, speeds, bending forces on axle journal transmitted via the axlebox, analysis of temperature etc. can be applied as supplementary tests in agreement between customer and supplier.

Before the real performance test, a pre-test shall be carried out. This does not constitute part of the official approval test for the bearings or grease being tested, but is intended to observe the thermal behaviour of the bearings while the grease is redistributed.

The performance test consists of repeating identical cycles up to an agreed cumulative distance. The number of cycles and the test distance reflect the service conditions of the intended application. Throughout the test, the performance of the bearings will 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 will be inspected and shall not show any changes beyond limits imposed.

6.2 Execution

6.2.1 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 and at the same time minimize influence from the rig. Especially, it shall be avoided that disturbances on one axlebox are transferred to the other axlebox.

An example of a test rig is schematically shown in A.1 and includes principally:

- a) axle or two synchronized axles, on which the axle boxes are mounted on the journals;
- b) rotation mechanism;
- c) device for measuring the rotational speed of the axle;

- d) device arranged to subject each axlebox to a constant radial force $F_r = F_{rn}$;
- e) measuring device to monitor this radial 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 force F_a ;
- h) ventilation equipment to simulate the cooling in operation;
- i) sensors permitting temperature measurement:
 - 1) in general, two sensors in the loaded zone of both axleboxes, aligned centrally above the bearing rows with typical positions shown in Figure A.2 for an axlebox with two bearings and in Figure A.3 for an axlebox with one bearing;
 - 2) in the scanning zone of the hot box detectors (HBD), by a sensor in direct contact with the surface of the body as indicated in Figure A.4 (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 the axle boxes, measured at the outlet of the cooling fans. It shall be measured for both axle boxes (see Figure A.1).

6.2.2 Test parameters

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6.2.2.1 General

The test parameters will be defined on the basis of the operating conditions of the vehicles to be equipped with these axle boxes and documented in accordance with Clause 4. The following test parameters are required, agreed and documented before the test and presented in the test report:

- a) reference vertical load F_0 (the axle load), in newtons;
- b) wheel diameter at the limit of wear d_{min} , in metres;
- c) vehicle speed limit v_{max} , in kilometres per hour;
- d) pre-test procedure;
- e) test cycle and cumulative test distance, in kilometres;
- f) original grease quantity and, if required, re-lubrication interval and grease quantity.

If deviations from the test parameters in A.4 and A.6 are agreed in order to simulate special operating conditions, this shall be indicated in the test report.

6.2.2.2 Rotational speed

The maximum rotational speed, maintained most of the time during the test, is that of a wheelset on which the wheels are at their limit of wear and where the rotational speed is derived from the vehicle speed limit, increased with a safety margin of 10 %. The resulting rotational speed is the nominal test speed, n , in revolutions per minute. The nominal speed in kilometres per hour is designated v_n .

$$n = \frac{110 v_{max}}{6 \pi d_{min}} \tag{1}$$

6.2.2.3 Radial and axial forces

The external 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.

Based on the load data specified in accordance with Clause 4, the values of radial and axial forces shall be calculated as defined in A.4 and the cycle of application of the axial load as defined in A.6. The axial force shall not be applied when the test speed is less than 20 % of the nominal test speed.

6.2.2.4 Air cooling

An air cooling system shall provide an air speed of 8 m/s to 10 m/s measured close to the axleboxes, with this average value taken from several points across each axlebox in the area impinged by the air stream. This cooling is maintained constant when the test is running, however not during the stops. An air temperature of 20 °C is recommended.

6.3 Carrying out the test

6.3.1 General

Unless otherwise agreed and documented in accordance with Clause 4, the test parameters, speeds and forces shall be those in 6.2.2, A.4, A.5 and A.6.

6.3.2 Pre-test

Before running the performance test, a pre-test shall be run. The objective of this test is to observe the thermal behaviour of the bearings and to redistribute the grease. The pre-test is illustrated in A.6. It consists of four cycles, each made up of two elementary trips, one in each rotational direction. The speeds are 25 %, 50 %, 75 % and 100 % of the nominal test speed, respectively. The radial force shall be maintained during the test; the axial force is applied as agreed, e.g. 25 %, 50 %, 75 % and 100 % of the calculated nominal axial force. Each elementary trip is made up of a speed increase, a constant speed, a slowing down and a stop.

The distance of each elementary trip is not predetermined; when the temperatures have stabilized – at least two hours within a 5 ° range – the trip is completed.

6.3.3 Performance testing

The test consists in repeating identical cycles at the nominal test speed to a specified cumulative distance. A cycle consists of two elementary trips, one for each direction of rotation, separated by a short stop and composed of a starting period, a period of constant maximum speed and a slowing down period to stop. The stop period may be prolonged if required.

The cumulative test distance (in kilometres), as well as the time at the nominal test speed during each cycle (in minutes), depends on the operating conditions in line traffic of the vehicles to be equipped with these axleboxes. The conditions defined in A.5 and A.6 are intended for main line vehicles, for other applications, the test parameters shall be in accordance with Clause 4.

6.4 Acceptance criteria

6.4.1 Results obtained during the test

Throughout the test, no defect in lubrication shall occur as evidenced by unsatisfactory temperature. Likewise, there shall be no bearing defects (spalling, breakage etc.) or seal failures.

Throughout the test, temperatures shall be measured, during each elementary test trip, at different loading zones and hotbox detector zone. The measured temperatures shall be expressed relative to an ambient temperature of 20 °C by re-calculation with the aid of the following equation

$$T_{z20} = T_{zm} - (T_a - 20) \quad (2)$$

where

T_{z20} is a temperature measured at a position z and then re-calculated to a temperature corresponding to an ambient temperature of 20 °C;

T_{zm} is a temperature measured at a position z (measured positions are loading zones and hot box detector zone);

T_a is the ambient temperature measured in the same time as T_{zm} and at the same side of the axlebox.

This calculation is applied only for the assessment of the first four criteria in A.7, Table A.2.

For each sensor position, the maximum temperature as well as the simultaneous differences between axleboxes shall be registered. Sufficient temperature data points shall be registered in order that the results may be interpreted according to the criteria of Table A.2.

For the further evaluation according to the Criterion 5 in Table A.2, the maximum value of those simultaneous differences shall be used (i.e. the hottest load zone temperature of the hottest axlebox shall be compared with the coolest load zone temperature of the coolest axlebox).

For consecutive elementary trips, the change of maximum temperatures for each load zone sensor position shall be noted and the maximum of those changes shall be used in the further evaluation according to the Criterion 7 in Table A.2.

The limits to be observed and the tolerable number of violations are given in A.7, Table A.2.

6.4.2 Results obtained after the test

On completion of the cumulative distance, the bearings shall be dismantled for examination; likewise grease samples from the zones indicated in A.3 shall be analysed. The mechanical criteria to be fulfilled by the bearings and the physico-chemical criteria to be fulfilled by the grease are defined in A.8.

The grease quantity remaining in the bearing should for information be determined and compared with the grease quantity before the test. For cartridge bearings, the grease quantity is documented according to EN 12080.

NOTE For cartridge bearings, the loss of grease after the test should normally be less than 10 % of the original amount.