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English Version

Railway applications - Axleboxes - Rolling bearings

Applications ferroviaires - Boîtes d'essieux -
Roulements

Bahnanwendungen - Radsatzlager - Wälzlager

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European foreword

This document (FprEN 12080:2017) has been prepared by Technical Committee CEN/TC 256 "Railway Applications", the secretariat of which is held by DIN.

This document is currently submitted to the Formal Vote.

This document will supersede EN 12080:2007+A1:2010.

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

- The list of normative references has been changed. Some references have been added;
- The list of "Terms and definitions" has been changed and new items added, e.g., "Supplier" has been replaced by "Manufacturer";
- Clause 4 that regulates "Information and requirements to be agreed and documented" has changed significantly, and 4.3 and 4.4 have been removed;
- The definition of "Dimensional stability" in Clause 6.2 is new and a new requirement for retained austenite for through hardened rings has been added;
- Clause 6.3 about "Traceability" is re-written with new requirements;
- Clause 6.4 about "Coatings" is new;
- Clause 7 about "Material properties" has new requirements on "Chemical composition" and "Inclusion content";
- Clause 10 "Physical properties" has several changes, e.g., the definition of "Soundness class" as well as that "Steel riveted brass cages" are no longer allowed;
- Clause 11 "Marking" is now more detailed and specifies marking of different "bearing types" – country of origin is no longer compulsory;
- The inspection plan in Clause 12 has been extended;
- A requirement for archiving of documents relating to quality records has been added in Clause 13;
- In Clause 14 a requirement for informing about changes relating to product approval has been added;
- Clause 15 has changes relating to grease batch approval, corrosion protection and packaging;
- In Annex A there are changes to the specification of "Preparation of rings";
- In Annex B there are changes to the specification of "Equipment";
- Annex D is now normative and has significant changes;
- Annex F is now normative and more specific on some criteria;
- Annex G is a new informative annex giving an example of an axlebox assembly.

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 2008/57/EC.

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

Introduction

This standard is part of a set of standards: EN 12080, EN 12081 and EN 12082.

This European Standard has been drawn up with the purpose of aiming at optimum performance in rail transportation. Performance implies a certain quality level of the vehicle running gear, which every railway undertaking may require, notably by imposing procedures in approval and requesting the existence of a quality assurance system for the supply of rolling bearings intended for rolling stock operating on its network or other networks in Europe.

1 Scope

This European Standard specifies the quality parameters of axlebox rolling bearings supporting the load of the vehicle, required for reliable operation of trains on European networks. It covers metallurgical and material properties as well as geometric and dimensional characteristics. It also defines methods for quality assurance and conditions for approval of the products.

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.

EN 10204, *Metallic products - Types of inspection documents*

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

EN 12082, *Railway applications - Axleboxes - Performance testing*

EN 13018, *Non-destructive testing - Visual testing - General principles*

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

EN ISO 178, *Plastics - Determination of flexural properties (ISO 178)*

EN ISO 179-1, *Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test (ISO 179-1)*

EN ISO 307, *Plastics - Polyamides - Determination of viscosity number (ISO 307)*

EN ISO 683-17:2014, *Heat-treated steels, alloy steels and free-cutting steels - Part 17: Ball and roller bearing steels (ISO 683-17:2014)*

EN ISO 1172, *Textile-glass-reinforced plastics - Prepregs, moulding compounds and laminates - Determination of the textile-glass and mineral-filler content - Calcination methods (ISO 1172)*

EN ISO 1183-1, *Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1)*

EN ISO 1183-2, *Plastics - Methods for determining the density of non-cellular plastics - Part 2: Density gradient column method (ISO 1183-2)*

EN ISO 2639, *Steels - Determination and verification of the depth of carburized and hardened cases (ISO 2639)*

EN ISO 3059, *Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conditions (ISO 3059)*

EN ISO 3451-1, *Plastics - Determination of ash - Part 1: General methods (ISO 3451-1)*

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

EN ISO 6508-1, *Metallic materials - Rockwell hardness test - Part 1: Test method (ISO 6508-1)*

EN ISO 6508-2, *Metallic materials - Rockwell hardness test - Part 2: Verification and calibration of testing machines and indenters (ISO 6508-2)*

EN ISO 6508-3, *Metallic materials - Rockwell hardness test - Part 3: Calibration of reference blocks (ISO 6508-3)*

EN ISO 9934-1, *Non-destructive testing - Magnetic particle testing - Part 1: General principles (ISO 9934-1)*

EN ISO 9934-2:2015, *Non-destructive testing - Magnetic particle testing - Part 2: Detection media (ISO 9934-2:2015)*

EN ISO 9934-3, *Non-destructive testing - Magnetic particle testing - Part 3: Equipment (ISO 9934-3)*

EN ISO 11357-3, *Plastics - Differential scanning calorimetry (DSC) - Part 3: Determination of temperature and enthalpy of melting and crystallization (ISO 11357-3)*

ISO 281, *Rolling bearings - Dynamic load ratings and rating life*

ISO 492, *Rolling bearings - Radial bearings - Geometrical product specifications (GPS) and tolerance values*

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

ASTM E45, *Standard Test Methods for Determining the Inclusion Content of Steel*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply (see also Annex G for more information).

3.1

customer

railway undertaking, rolling stock manufacturer, Entity in Charge of Maintenance (ECM) or buyer of railway rolling stock or subassemblies, or their representative

3.2

railway undertaking

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

3.3

manufacturer

manufacturer of axlebox rolling bearings produced under their responsibility

3.4

network

infrastructure, on which any railway undertaking can operate rolling stock

3.5

axlebox (assembly)

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

Note 1 to entry: Further components, e.g., bearing sleeve, housing cover(s), axle end cap components and fasteners may also be part of the assembly. This depends on axlebox type and design (see Annex G).

3.6

bearing sleeve

component of box housing which contains rolling bearing(s), grease and sealing

3.7

housing cover

component which retains the bearing in the housing or bearing sleeve

3.8

axle end cap components

components which secure the rolling bearing axially on the journal

3.9

rolling bearing

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

3.10

cartridge bearing

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

3.11

ring

annular part of a rolling bearing incorporating one or more raceways with rolling element contact

3.12

rolling elements

cylindrical, tapered or convex rollers or balls

3.13

cage

component, which partly surrounds the rolling elements and moves with them

3.14

grease

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

3.15

seal

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

3.16

box housing

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

3.17

rolling bearing type

designation of the rolling bearing or cartridge bearing according to the shape of the rolling elements (e.g. tapered roller bearing, cylindrical roller bearing, and spherical roller bearing)

3.18

rolling bearing design

designation of a specific rolling bearing or cartridge bearing design within a rolling bearing type (e. g. WJ/WJP 130x240x80 P.C3), bearing design is a subset of a bearing type

3.19

ribs and thrust collars

annular component of a rolling bearing transmitting axial forces (separate from the bearing inner or outer rings) in contact with the rolling element end face in cylindrical roller bearings

4 Technical specification

4.1 General requirements

The supply of a component or a service (rig tests, field test, calculations, etc.) shall be based on a comprehensive specification. This specification shall consist of all the information relevant for design and manufacture of the bearing describing the functional requirements over its complete life cycle and the interfaces with associated components and assemblies.

The design and validation process requires the integration of different disciplines and areas of expertise and the knowledge associated with them. Therefore, the specification shall include information defining the intended operating conditions, calculation and test parameters.

The following information shall be part of the approval process and be fully documented in the technical specification by either of the contracting parties. Both the requirements specified throughout this European Standard and the following documented requirements shall be satisfied before a claim of compliance with this European Standard can be made and verified.

4.2 Technical specification content

The technical specification shall contain at least the following information and requirements:

NOTE Usually the customer is responsible for items 1) to 6). Items 7) to 21) are usually subject to agreement between contracting parties.

- 1) interface drawing showing mounting conditions; all dimensions of the space available for the rolling bearings; dimensions, tolerances and materials of shaft and box housing;
- 2) load specification at least according to EN 12082;
- 3) ambient temperatures in operation;
- 4) if required, special steel composition, cleanliness and soundness class (see 7.1 and 10.2);
- 5) approval procedure type and conditions to be applied (see Clause 14 and Annex E);
- 6) special conditions for quality records and traceability (see 6.3 and Clause 13);
- 7) boundary dimensions and interface tolerances of the rolling bearing (see Clause 8);
- 8) type of coating and influence on boundary dimensions (see 6.4);
- 9) internal clearance measurement process and clearance values before and after mounting (see Clause 8);
- 10) references to standards and special requirements (see Clause 7 and 10.2);

- 11) use of steel of special composition, manufacture or metallurgical quality (see 7.1);
- 12) soundness Class, 1 or 2, and the test methods to be used (see 10.2 and A.4.2);
- 13) type of heat treatment to be applied and methods of testing (see 6.2, 10.3, 10.4 and 12.2);
- 14) marking (see Clause 11);
- 15) inspection plan (see 12.1);
- 16) for cartridge bearings grease designation, quantity and distribution (see 15.1);
- 17) for non-sealed bearings, grease designation and compatibility with preservatives (see 15.2);
- 18) selection of mechanical testing method for cages of polymeric material (see D.4.1);
- 19) material data sheet for polymer cage material;
- 20) proof of batch release according to EN 12081 for traceability;
- 21) method for determining steel cleanliness.

5 Quality systems

The quality of workmanship and manufacturing shall be demonstrated to ensure the requirements of the technical specification are met.

NOTE 1 The manufacturer is responsible for this.

NOTE 2 Quality management system according to EN ISO 9001 is usually used.

NOTE 3 The system used for non-destructive testing staff is usually according to EN ISO 9712.

6 Manufacture

6.1 Steel manufacturing

The process of steel manufacture in mass production shall be such that the metallurgical characteristics are the same as those of the rolling bearings submitted for the approval procedure.

6.2 Heat treatment

The heat treatment processes for the rolling bearing components shall be such that the hardness values specified in 10.3 and/or 10.4) are respected. The heat treatment processes shall be such that all the rolling bearings produced in a production batch are treated uniformly.

The bearings shall be heat-treated to retain dimensional stability for one of the two following temperature categories:

- 150 °C
- 200 °C

The temperature category shall be given and documented in the Technical specification (Clause 4).

The bearings (inner and outer rings) shall be heat-treated to retain dimensional stability at least for operating temperatures up to 150 °C.

Inner rings of cylindrical roller bearings that are heated during mounting or dismounting shall be dimensionally stable up to 200 °C.

The retained austenite content for inner rings made of through-hardened rolling bearing steel must be:

- 150 °C : ≤ 3.0 % with a measuring accuracy of ± 1 %;
- 200 °C : ≤ 2.0 % with a measuring accuracy of ± 1 %.

For other steels, the retained austenite content must be defined in the course of the (type) approval procedure.

The inspection frequency of the retained austenite content is specified in Table 3 — Inspection plan, 12.1. The method of measurement of retained austenite is to be defined in the technical specification (Clause 4).

6.3 Traceability

For the manufacturing process a system of identification and traceability of finished products shall be set up and maintained. This system shall allow identification, of the following elements:

- Raw material for rings and rollers;
- Inspection certificate 3.1 in accordance with EN 10204 or equivalent. Minimum content:
 - o Chemical analysis (all elements);
 - o Steel production method;
 - o Microstructure (CN, CG, CZ);
 - o Inclusion content (see 7.2.2);
- Polymeric cages:
 - o Raw material (granulate material) + raw material manufacturer;
 - o Inspection results; inspections at least in accordance with EN 12080, Annex D;
 - o Manufacturer, manufacturer's mark, date of manufacture;
- Rolling bearing grease:
 - o Name, manufacturer ;
 - o Inspection certificate 3.1 in accordance with EN 10204 or equivalent. The content of the certificate is according to EN 12081.
- Production locations of rings and rollers;
- Traceability of heat treatment:
 - o Method;
 - o Temperature variations including nominal and actual values per heat treatment batch;
 - o Microstructural examination per heat treatment batch;

- o Hardness values/case-hardening depth of rings and rollers in accordance with EN 12080, **Error! Reference source not found., Error! Reference source not found.;**
- o Retained austenite content, inspection frequency in accordance with 6.2;
- o If there are several heat treatment batches per production batch they must be assignable to the production batch;
- Significant changes in the finishing process after heat treatment that could lead to defects, e.g., so called "grinding burns";
- Traceability of the inspection results in accordance with the inspection plan, (see 12.1);
- Quality records in accordance with Clause 13 and records of inspection plans, inspection instructions and calibrations.

6.4 Coatings

6.4.1 General

The type of coating used for the bearing boundary surfaces shall be agreed and documented in accordance with Clause 4. Distinction shall be made between permanent coatings (e.g. for electrical insulation) and non-permanent coatings (e.g. phosphate coating for corrosion protection).

6.4.2 Permanent coating

The dimensions in the finished state (including the coating) shall apply for approval and use of the bearing.

6.4.3 Non-permanent coating

The dimensions before coating shall apply for approval and use of the bearing and the thickness of the non-permanent coating shall be considered separately. Boundary dimensions shall be documented both for the coated and the uncoated state.

7 Material properties

7.1 General

The grades and qualities of materials used shall conform to the requirements in 7.2 and 7.3.

7.2 Steel for rings and rolling elements

7.2.1 Grades

Steels should be selected from the grades specified in EN ISO 683-17. Alternative steel grades may be used if specified in the technical specification. For particular applications (high rotational speed, reliability etc.) it may be requested that the rolling bearings are made from steel with special composition, metallurgical quality or manufacturing processes (Clause 4).

Additional requirements regarding the chemical composition (content in %) after the ladle analysis in accordance with EN ISO 683-17 are listed below in Table 1 — Additional requirements, chemical composition, through hardened steel and Table 2 — Additional requirements, chemical composition, case carburised steel below.

Table 1 — Additional requirements, chemical composition, through hardened steel

| Element | Minimum | Maximum |
|----------------|---------|---------|
| Ti | 0 | 0.003 |
| H ₂ | 0 | 0.000 2 |

Table 2 — Additional requirements, chemical composition, case carburised steel

| Element | Minimum | Maximum |
|----------------|---------|----------|
| Ti | 0 | 0.005 |
| H ₂ | 0 | 0.000 25 |

7.2.2 Inclusion content

The methods for determining the inclusion content shall be in the technical specification.

The methods in accordance with ASTM E45 (Method A) and ISO 4967 (Method A) are permitted. For the methods mentioned above, the limit values in accordance with EN ISO 683-17:2014, Annex A, Tables A.1 and A.2 are authoritative.

The frequency and scope of inspection for inclusion content of raw material (bar, tube or billet) is specified in Table 3 — Inspection plan, Clause 12.1).

When needed - inspection of single rings and rollers can also be made according to the methods and requirements specified above providing enough samples are taken to form an average value.

NOTE ASTM E45 gives a recommendation for number of samples.

For steel with special composition, metallurgical quality or manufacturing processes, the inclusion content shall be documented in accordance with Clause 4.

7.3 Materials of other components (cages, spacers, seals etc.)

The materials of each one of these components shall be documented in in the technical specification in accordance with Clause 4. For cages of polymeric material, if not otherwise specified, refer to Annex D.

8 Geometry and dimensions

8.1 Dimensions and tolerances

The boundary dimensions shall be given in the technical specification, and the applicable tolerances shall be those given in ISO 492, normal tolerance class, unless given and documented in the technical specification in accordance with Clause 4.

8.2 Rolling bearing internal clearance

8.2.1 Rolling bearing clearance before mounting

Rolling bearing internal clearance, axial and/or radial, depending on the type of rolling bearing, shall conform to the values given in the technical specification. The methods for radial and/or axial clearance inspection shall be described and documented in the technical specification in accordance with Clause 4.

8.2.2 Rolling bearing clearance after mounting

Rolling bearing clearance after mounting on an axle is a calculated value used for checking the clearance after mounting. The values for clearance after mounting shall be described and documented by the manufacturer in accordance with Clause 4.

9 Mechanical properties — inner ring expanding ability

With the exception of case-hardened rings and bainite hardened rings, an expansion test shall be performed to guarantee that the inner rings can withstand an increase of the bore diameter without causing fracture in service. This test shall be performed before the inspection for surface soundness. The value of this diameter increase shall not be less than 0.0015 times the diameter. The rings shall neither rupture nor show any traces of cracks (see 10.2.3). This expansion test shall be made with an expandable mandrel that is inserted in the bore of the inner ring. The expansion shall be achieved progressively in a few seconds.

10 Physical properties

10.1 Visual aspect

10.1.1 Rings and rolling elements

Rings and rolling elements shall be free of any defects which can be harmful to their function (such as burrs, scratches, rust stains, nicks and dents). A defect catalogue to define the acceptance limits for visual defects shall be created and maintained.

NOTE Usually the manufacturer is responsible for maintaining a defect catalogue.

10.1.2 Cages

Rolling bearing cages shall exhibit no defects that might affect their function (such as burrs, scratches, rust). To avoid crack initiation, the connection between the cage bars and the annular body shall be smooth and conform to the rounding-off shown on the detail drawing.

The requirements for cages of polymeric material shall be taken into account (see Annex D).

For cages other than polymeric cages the approval process shall be defined in the technical specification. Steel riveted brass cages are not allowed.

10.2 Soundness of rings and rolling elements

10.2.1 General rules

Rings and rolling elements shall have no internal defects, nor any form of surface defect that may be harmful to their function. The methods for the soundness inspection are described in Annex A, Annex B and Annex C. Any alternative methods to be used, which give equivalent results, shall be documented in the technical specification in accordance with Clause 4.

Two soundness classes are defined:

- Class 1 for vehicles with $n \times d_m > 250\,000$ [mm/min] or a vehicle speed > 200 km/h or axle load ≥ 25.0 t;
- Class 2 for vehicles with $n \times d_m \leq 250\,000$ [mm/min].

The classification only concerns the internal soundness of the ring (see Annex A). The soundness class is assigned as part of the approval procedure where:

- n is the maximum operational speed of rotation of the inner ring, in revolutions per minute;
- d_m is the bearing mean diameter $(D + d)/2$, in millimetres;
- D is the bearing outside diameter, in mm;

— d is the bearing bore diameter, in mm.

NOTE The value $n \times d_m = 250\,000$ [mm/min] corresponds to a wheel diameter of 840 mm, a bearing mean diameter of $d_m = 195$ [mm] and a vehicle speed of 200 [km/h].

10.2.2 Internal soundness of rings

The reference method for the inspection of internal soundness of rings is described in Annex A. Inspection of internal soundness of rings can also be carried out with an approved equivalent, standardised inspection method capable of detecting at least the same defects as the reference method. Use of an equivalent method shall be agreed and documented in the technical specification in accordance with Clause 4.

When tested, no ring shall exhibit defect indications on the raceway, or in a section of 4 [mm] depth below the raceway, with the amplitude equal to or greater than that observed with the master defect corresponding to the soundness class in question in accordance with Annex A. Larger defects are tolerated deeper than this section, though the defect indications shall not be more than twice the amplitude of that observed with the master defect.

10.2.3 Soundness of ring surfaces

The reference method for the inspection of surface soundness of rings is described in Annex B. When tested, no evidence of defects shall be observed on any of the ring surfaces. Surface soundness inspection of rings can also be carried out with an approved equivalent, standardized inspection method, e.g. a calibration and test procedure analogous to the eddy current testing of rollers in Annex C.

10.2.4 Soundness of roller raceway surfaces

The reference method for the inspection of the raceway surface soundness of rollers is described in Annex C. When tested, no roller shall exhibit defect indications on its raceway with amplitude equal to or greater than that observed with the master defect as defined in Annex C.

10.2.5 Grinding burns

There shall be no grinding burns during the different grinding operations.

10.3 Case depth

For rolling bearings manufactured of case-hardened steel, the effective depth of the hardened case shall be documented in accordance with Clause 4. The depth of the hardened case is determined as a function of the change in hardness of the transversal cross section of a test piece or a prepared sample. The hardness shall be measured in accordance with EN ISO 6507-1 and EN ISO 2639 or another process agreed and documented in accordance with Clause 4. At this depth, the Vickers hardness shall be at least 550 HV1.

Inspection methods other than those described in ISO 6507-1 and EN ISO 2639 can be approved during the course of the approval procedure if equivalence is demonstrated.

10.4 Surface hardness

Rings and rolling elements shall have a Rockwell hardness (HRC) between 57 HRC and 66 HRC.

There shall be no more than 4 HRC difference between the values measured:

- on all the rings of one rolling bearing;
- on all the rolling elements in one rolling bearing.

Surface hardness shall be inspected according to the Rockwell method, referred to in EN ISO 6508-1, EN ISO 6508-2 and EN ISO 6508-3. For case-hardened steel rolling bearings, surface hardness may be measured by the Vickers HV 30 method, referred to in EN ISO 6507-1, or by another equivalent method agreed and documented in accordance with Clause 4.

Inspection methods other than those described in ISO 6507-1 can be approved in the course of the approval procedure if requested by the manufacturer who needs to demonstrate equivalence.

11 Marking

11.1 General

Rolling bearings shall be marked visibly and indelibly away from any surfaces in contact with spacers, thrust rings etc. Should this not be possible, the marking area shall be documented in the technical specification in accordance with Clause 4.

The format of marking shall be documented on the bearing drawing.

Where marking punches are used, these shall not have any sharp edges. Marking by electric pencil (spark erosion) is prohibited.

If no other indications are given, the following marking is compulsory:

- manufacturer's trade mark;
- production plant code;
- rolling bearing designation;
- country of origin, reference to this European Standard and the soundness class are all optional as marking;
- year of manufacture in un-coded form and indication of month (coded or un-coded) or instead of month – day of manufacture within the year:
 - Two digits or one letter shall be used to indicate month of manufacture;
 - Three digits shall be used to indicate day of manufacture within the year;
- the preferred marking format is MY where M stands for the number of the month (01-12) and Y stands for the two last digits of the year. For example, a bearing manufactured in May 2018 would have the marking 0518, or 12518 for 125:th day of the year 2018 or E18 for month coded with a letter.

Each part of this marking information shall be separated by a space or special character.

When rolling bearing components or sub-assemblies are not allowed to be interchanged, they shall be marked with a unique identification number.

11.2 Marking of rings for cylindrical roller bearings (CRB)

Cylindrical rolling bearings (CRB) for axleboxes shall be marked with capital letters W, WU, WJ, WJP, etc. regardless of whether a manufacturer uses a drawing number or NJ-, NU or other designations internally.

Inner rings of cylindrical roller bearings with ribs or thrust collars shall be marked on the relevant "Front face" according to Clause 11.1 and on the "Chamfer side" according to Figure 1 — Marking of CRB inner rings. Additional marking shall be according to Clause 11.1.

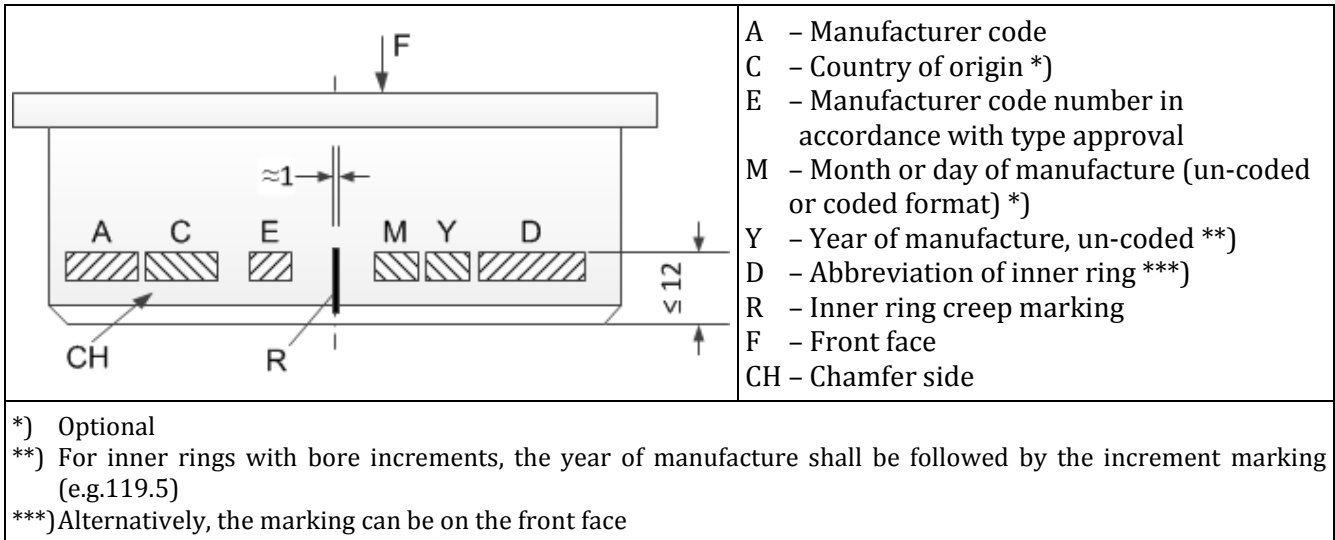


Figure 1 — Marking of CRB inner rings

11.3 Marking of cartridge bearings for axleboxes

For self-contained cartridge bearings it is sufficient to mark only the outer ring provided that the marking is visible on the exterior of the bearing. Bearings shall be marked (location and format) according to Figure 2 — Marking of cartridge bearings.

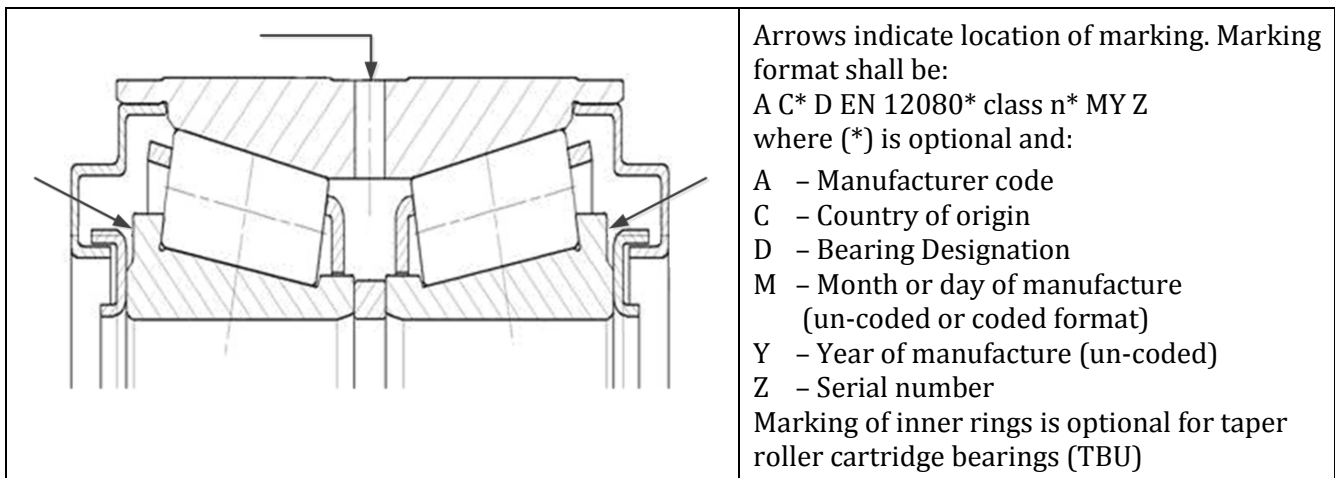


Figure 2 — Marking of cartridge bearings

11.4 Marking of spherical roller bearings (SRB)

For spherical roller bearings (SRB) the outer ring shall be marked according to Figure 3 — Marking of spherical roller bearings.

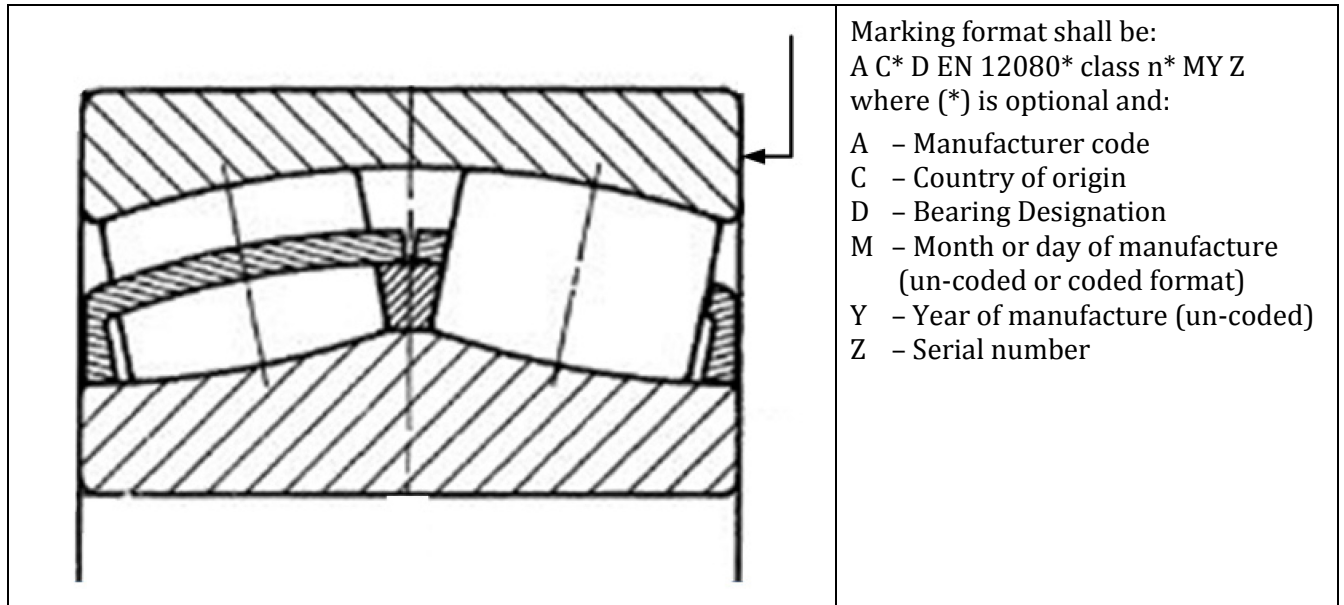


Figure 3 — Marking of spherical roller bearings

11.5 Prefix and postfix

For a roller bearing with significant deviations with respect to external dimensions that do not require a new approval procedure the designation shall be modified with a prefix or postfix. For example: XLWJP 120x240 – inner ring with smaller bore diameter; manufactured ring has a diameter of only $\varnothing 119.5$ mm instead of $\varnothing 120.0$ mm.

12 Inspection

12.1 Inspection plan

If not otherwise documented in accordance with Clause 4 the sampling plan and the number of inspections to be undertaken shall be in accordance with Table 3 — Inspection plan. The results shall be documented.

Table 3 — Inspection plan

| Nature of inspections | Number of inspections to be performed for a batch of <i>N</i> components or bearings | | | | | |
|---|--|--------------------|---------------------|----------------------|----------------------|----------------|
| | <i>N</i> ≤ 10 | 10 < <i>N</i> ≤ 50 | 50 < <i>N</i> ≤ 100 | 100 < <i>N</i> ≤ 250 | 250 < <i>N</i> ≤ 500 | <i>N</i> > 500 |
| Visual aspect | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Functional dimensions ^a | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Surface soundness ^b | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Internal soundness ^c | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Case depth ^b | 1 | 1 | 2 | 3 | 4 | 5 |
| Hardness ^b | 1 | 2 | 3 | 5 | 7 | 10 |
| Inclusion content | h | h | h | h | h | h |
| Coating (See 6.4) | 1 | 2 | 3 | 5 | 7 | 10 |
| Retained austenite | g | g | g | g | g | g |
| Internal clearance ^d | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Inner ring expansion ability ^e | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Marking | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Polymer cages | f | f | f | f | f | f |

If a component or a bearing is found to be faulty:
 — if inspection by sampling, the whole batch shall be rejected or 100 % inspected,
 — faulty component or rolling bearing shall be rejected, in case of 100 % inspection.

- a In accordance with Clause 4.
- b On outer and inner rings, on rolling elements and on loose ribs and thrust collars.
- c On outer and inner rings.
- d Radial clearance for cylindrical and spherical roller bearings; axial clearance for cartridge bearings and matched pairs of tapered roller bearings. It is valid to calculate the axial / radial clearance(s) on basis of measured values of rings and rollers, for manufacture of cylindrical cartridge roller bearings.
- e Except case-hardened rings and bainite hardened rings.
- f See Annex D.
- g One ring every third month in continuous production for comparable bearing types with a comparable heat treatment method
- h For ingot casting once every steel melt. For continuous casting for beginning, middle and end of the casting process. Samples to be taken after forging and heat treatment on forged bars.

12.2 Sampling

A sample consists of rolling bearings or components taken from one batch and selected at random.

When the heat treatment is continuous, the sampling plan shall be documented in the technical specification in accordance with Clause 4. If the sampling is made by the customer, samples are taken at random from each batch of the rolling bearings chosen by the customer for inspection.

For the checking of hardness and case depth of rings, one or more sectioned parts of rings from the same furnace batch may be used. Alternative samples may be used after agreement with the customer.

13 Quality records

Independent of other regulations, the requirements for the archiving of all records of control of quality, providing proof of product conformity to this European Standard, and to the special terms of the order, shall be defined by the customer and documented in accordance with 4.2.

The manufacturer must keep all quality records, i.e., test records, calibration certificates, raw material certificates, (see 6.3) for at least ten years.

14 Approval

Rolling bearings shall pass an approval procedure as and documented in the technical specification in accordance with Clause 4.

Every new type of rolling bearing or new application (see Annex F) shall be submitted to an approval procedure. This procedure shall be specified in accordance with the criteria presented in Annex E.

Any changes relating to the requirements that led to the approval may require a new approval procedure; guidelines are given in Annex E and Annex F.

15 Delivery and packing

15.1 Greasing of rolling bearings

When it is specified that the rolling bearings shall be delivered pre-lubricated with grease, this shall be with grease approved in accordance with EN 12081. The grease type, the quantity and its distribution shall be documented in accordance with Clause 4.

Grease manufacturing, batch quality inspection and validation shall be according to EN 12081.

15.2 Corrosion protection

All rolling bearings shall be delivered protected against corrosion. The product used to protect the bearing shall be free from toxic or harmful substances according to the current regulations.

NOTE In particular, but not limited, to REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals).

The compatibility of the preservative with the lubricating grease shall be guaranteed and documented in accordance with Clause 4.

The corrosion inhibitor shall permit a minimum storage time of two years under normal storage conditions provided that the original packing has not been opened.

15.3 Packaging

Whether delivered in bulk or singly, all rolling bearings shall be effectively protected by appropriate packaging such that they can be transported, handled and stored without any damage.

The following minimum marking will be made on the packaging:

- manufacturers trade mark;
- rolling bearing designation.
- date of packaging;
- additional marking as agreed between customer and manufacturer.

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The packaging shall permit a minimum storage time of two years under normal storage conditions and provided that the original packing has not been opened.

For rolling bearings delivered pre-lubricated, the storage time from manufacture to mounting the bearing on axle is limited to 24 months indoors between -5° C and +40 °C. Out of this 24 months period, a maximum of 12 months shall be at bearing manufacturer's.

Annex A (normative)

Ultrasonic inspection of rolling bearing rings

A.1 Purpose

The purpose of this annex is to detail a reference method of ultrasonic inspection to verify the metallurgical soundness of rolling bearing rings for non-metallic inclusions, voids, etc.

A.2 Principle

The ultrasonic inspection is carried out to accepted industrial practice, together with the requirements below.

The test consists of the generation of pulses and reception of echoes in the form of longitudinal waves, so that the direction of propagation of waves through the rings is perpendicular to the raceway.

Defects are indicated on the screen display:

- either by attenuation of the “back echo” from the raceway;
- or presence of “defect echoes” with attenuation of the “back echo” (see Figure A.2 — Indication of defects on the screen display).

A.3 Equipment

The inspection equipment consists of an ultrasonic appliance allowing inspection by the “pulse-echo principle”, consisting in particular of:

- an ultrasonic testing device which shall comply with EN 12668-1 or equivalent industrial standard;
- a monitoring system that trips an alarm whenever the defect indication is equal to or greater than the acceptance criterion;
- a transducer of minimum frequency 5 MHz ensuring the detection sensitivity specified in A.4.4.2;
- a “go/no go” ring sorting system.

A.4 Operating procedure

A.4.1 General rules

Examination and detection of defects shall be carried out automatically.

A.4.2 Preparation of rings

The inspection can be carried out on ground and thoroughly cleaned rings. Inspection of rings with a different manufacturing state can be agreed according to Clause 4. The calibration rings shall be in the same manufacturing state as the inspected rings.

A.4.3 Examination

The total volume under the raceways is scanned:

- by relative rotation of the rings and the transducer;
- by moving the transducer or the rings sideways, while continuously adjusting the orientation of the transducer when testing spherical roller bearings (see Figure A.1 — Examples of applications).

The travelling speed of the ring in front of the transducer shall allow for the response time of the system.

The axial step of every rotation of the ring shall be less than the diameter of the beam or of the focal spot when the beam is focused.

A.4.4 Calibration

A.4.4.1 Distance

The distance, displayed as the dial abscissa, shall be sufficient to display at least one to-and-fro movement of the ring within the greatest thickness sensed, beyond its passage through the liquid.

A.4.4.2 Sensitivity

Sensitivity is set with calibration rings identical to the rings being tested (see Figure A.3 — Calibration rings), with reference defects in the form of flat bottomed holes in the raceway:

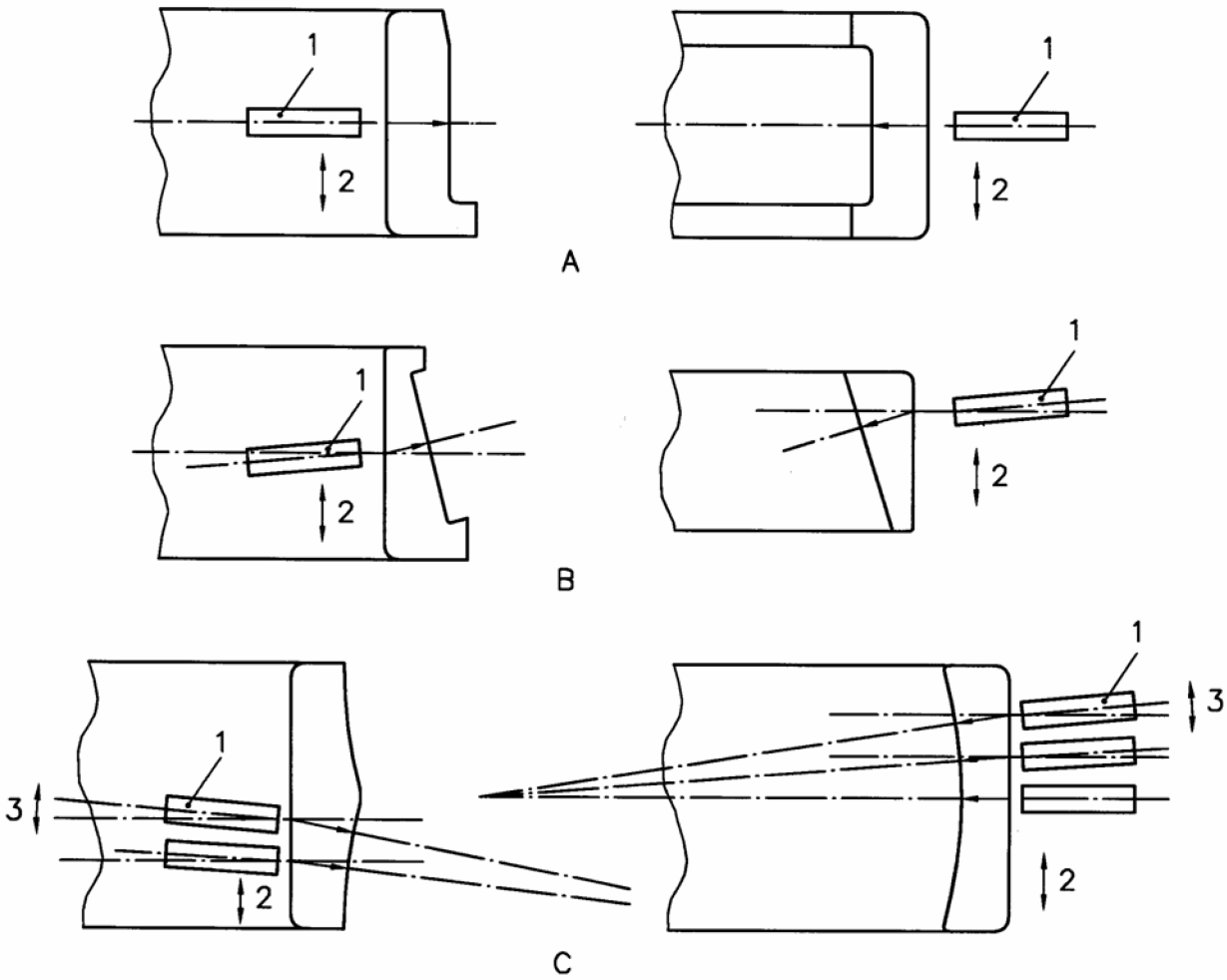
- 0,5 +/- 0.05 mm in diameter and 0,5 +/- 0.05 mm deep for Class 1 rolling bearings;
- 1 +/- 0.05 mm in diameter and 1 +/- 0.05 mm deep for Class 2 rolling bearings.

A.4.4.3 Automatic monitoring system

The automatic monitoring system is set in all cases to trip the alarm and to reject parts, which cause any response of defect equal to or greater than the weakest response observed on the calibration ring (see Figure A.3 — Calibration rings).

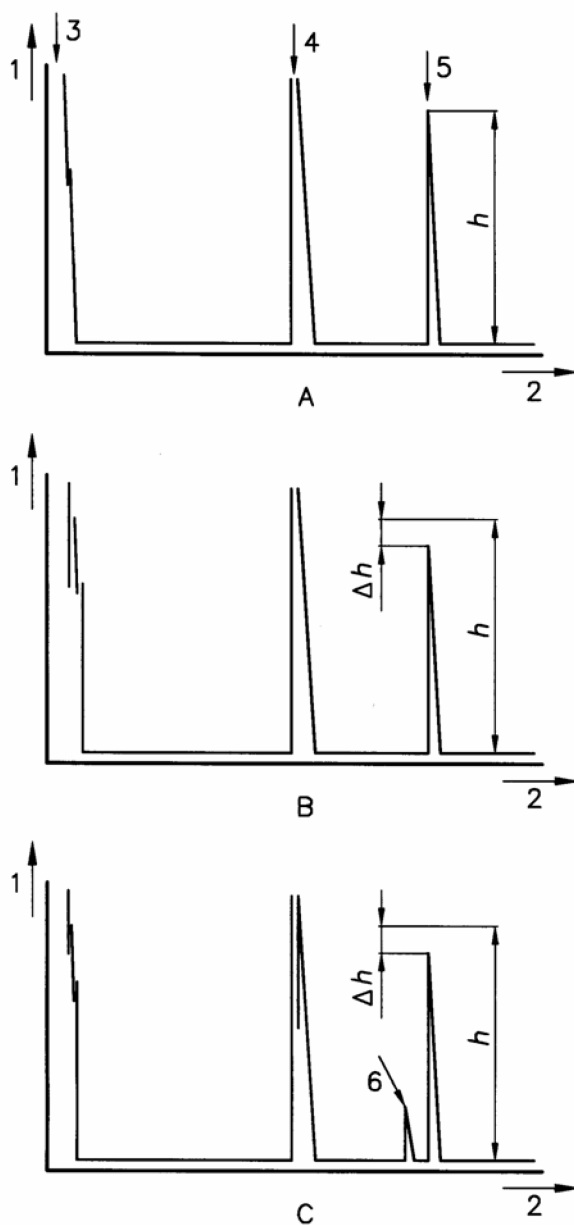
A.4.4.4 Verification

To verify the operational stability, the equipment shall be regularly checked by means of the calibration ring under the same conditions as the rings being inspected (examples see Figure A.1).



- Key**
- 1 probe
 - 2 displacement
 - 3 orientation
 - A cylindrical roller bearing
 - B tapered roller bearing
 - C spherical roller bearing

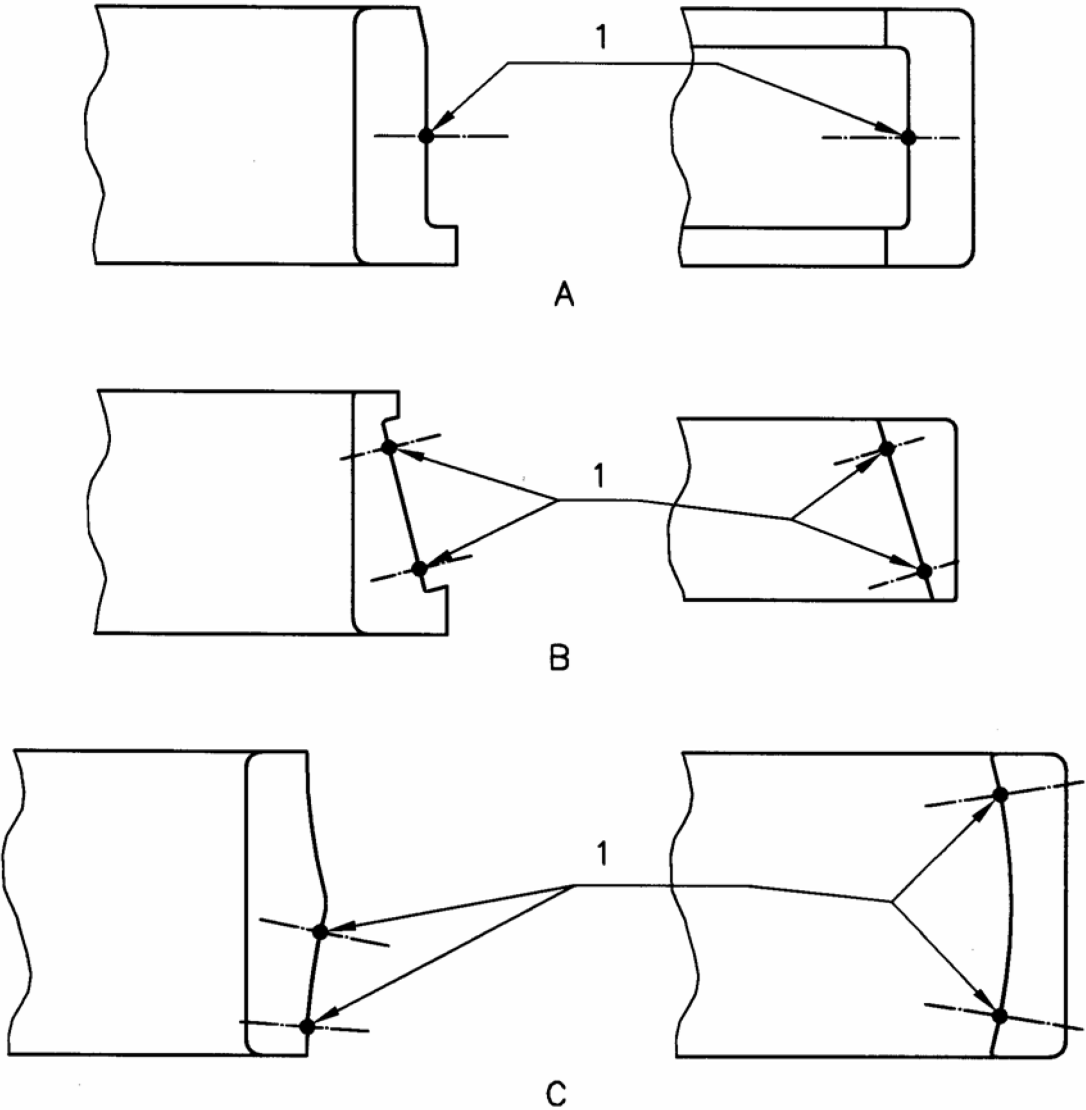
Figure A.1 — Examples of applications



Key

- 1 pulse
- 2 time
- 3 initial pulse
- 4 input signal
- 5 back echo
- 6 defect echo
- A sound area
- B area with defects – attenuation of the back echo
- C area with defects – defect echo and attenuation of the back echo

Figure A.2 — Indication of defects on the screen display



- Key**
- 1 reference defect
 - A cylindrical roller bearing
 - B tapered roller bearing
 - C spherical roller bearing

Figure A.3 — Calibration rings

Annex B (normative)

Magnetic particle inspection of ring surfaces

B.1 Purpose

The scope of this annex is to detail a reference method for magnetic particle inspection intended to detect ring surface defects such as grinding cracks, heat treatment or hardening cracks, rolling or forging shuts, scratches, etc.

B.2 Principle

The magnetic particle inspection is to be carried out according to EN 9934-1 together with the requirements below. The inspection is achieved by magnetisation:

- in the circumferential direction for the detection of defects parallel to the axis of the ring, called "axial defects" (see Figure B.1); and
- parallel to the axis of the ring for the detection of circumferential defects (see Figure B.2).

B.3 Equipment

The inspection equipment employed shall be capable of achieving magnetisation of the ring as specified above with a magnetic field strength of minimum 3 kA/m RMS for each direction of magnetisation. The induction level is identified by the intensity of the magnetising current.

Defects are detected using a magnetic solution containing fluorescent particles. Such liquid shall have no harmful effects on the parts being examined. The inspection is carried out under UV-light of at least 15 W/m² light intensity, measured at a distance of 300 mm (equivalent to 10W/m² at 400 mm).

A verification of the system sensitivity shall be carried out on site. This includes measuring the field strength as well as the use of reference rings with real defects of known type, location, size and distribution. Where these are not available, fabricated reference rings with artificial defects may be used.

The fabricated reference rings shall be of the same type and geometry as the parts being tested. The artificial defects (both in axial and circumferential direction – see Figure B.1 — Circumferential magnetisation to detect axial defects and Figure B.2 — Axial magnetisation to detect circumferential defects) shall have the following dimensions:

- 0,05 mm ± 0,01 mm deep, 3 mm ± 0,1 mm long and 0,05 mm ± 0,01 mm wide.

An alternative solution to the use of fabricated reference rings with artificial defects is to verify all measurements according EN ISO 9934-1:

- controlling magnetic field according to EN ISO 9934-3;
- indication sensitivity of the detection medium with master sample type 1 or 2 according to EN ISO 9934-2:2015, Annex B;
- UV-light efficiency according to EN ISO 3059 with the inspection carried out under UV-light of at least 15 W/m² light intensity, measured at a distance of 300 mm.

B.4 Operation procedure

B.4.1 Preparation of rings

The inspection shall be carried out on ground and thoroughly cleaned rings.

B.4.2 Examination

All surfaces shall be examined taking care not to remove any defect indications. All rings with defect indications shall be rejected.

B.4.3 Demagnetisation

After examination the rings shall be demagnetised. The residual magnetism shall not exceed 0.4 kA/m.¹⁾

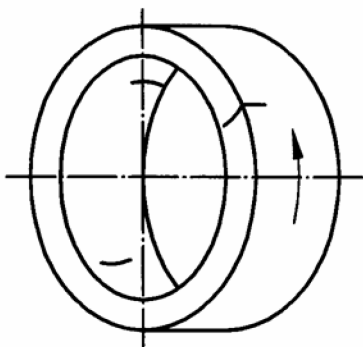


Figure B.1 — Circumferential magnetisation to detect axial defects

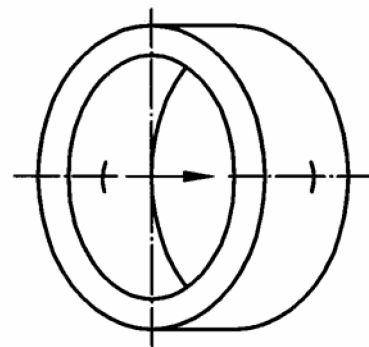


Figure B.2 — Axial magnetisation to detect circumferential defects

1) For steel components the value 0.4 kA/m of the magnetic field is equivalent to the value of 0.5mT of the magnetic induction.

Annex C (normative)

Eddy current inspection of the raceways of the rollers

C.1 Purpose

The scope of this annex is to detail a reference method of inspection using eddy currents for the detection of defects on the raceway surface of rollers such as grinding cracks, heat treatment or hardening cracks, lines and scores due to drawing, marks, etc.

C.2 Principle

Eddy current inspection of rollers is to be carried out using an inductive sensor, in which a high frequency alternating current is passed (of at least 100 kHz).

The raceway surface of the rollers is scanned by relative rotation and relative axial movement between the roller and the sensor, with the distance between them remaining constant (see Figure C.1 — Eddy current inspection of roller raceways — Calibrated reference roller).

The inspection is carried out automatically.

C.3 Equipment

The equipment consists of:

- a system designed to energize the sensor and detect variations of impedance due to defects to be detected;
- a sensor with a differential winding;
- a monitoring system which trips an alarm whenever the detected response is of a level equal to or greater than the acceptance criterion;
- a go / no go roller sorting system.

C.4 Operating procedure

C.4.1 Preparation of rollers

The inspection shall be carried out on finished and thoroughly cleaned rollers.

NOTE The inspection can also be carried out on rollers after final grinding in order to avoid the risk of handling marks after honing.

C.4.2 Examination

The speed at which the rollers pass in front of the sensor shall allow for the response time of the system. The axial displacement pitch for every rotation shall be less than the effective width of the probe.

C.4.3 Calibration

C.4.3.1 Sensitivity

The sensitivity is calibrated with reference rollers of identical material and geometry as the parts being tested, provided with a reference artificial defect in the form of a longitudinal slot (see Figure C.2 — Eddy current inspection of roller raceways — Calibrated reference roller) of the size:

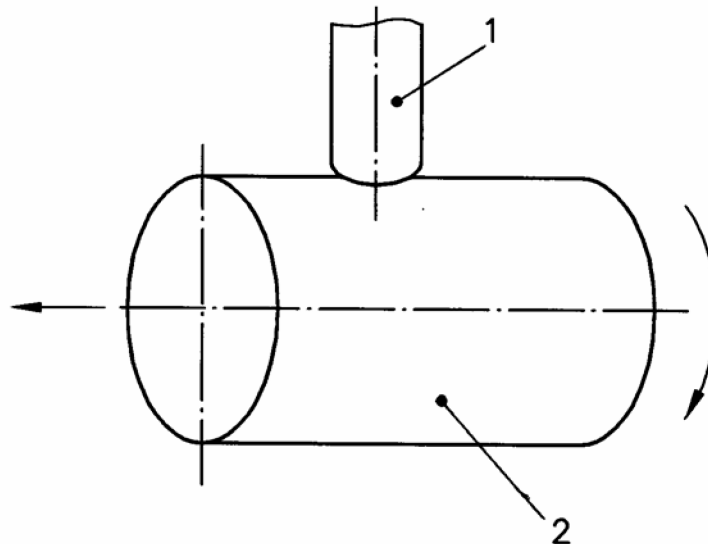
— 0,05 mm ± 0,01 mm deep (p), 3 mm ± 0,1 mm long (L) and 0,05 mm ± 0,01 mm wide (l).

C.4.3.2 Automatic monitoring system

The automatic monitoring system is set in each test to trip an alarm, and to reject parts whenever the amplitude of the signal is equal to or greater than that generated by the reference defect.

C.4.3.3 Verification

To verify the operational stability, the equipment shall be regularly calibrated by means of the calibration rollers under the same conditions as the rollers being inspected.



Key

- 1 probe with differential coils
- 2 roller submitted to a relative rotating movement with respect to the probe

Figure C.1 — Eddy current inspection of roller raceways — Calibrated reference roller

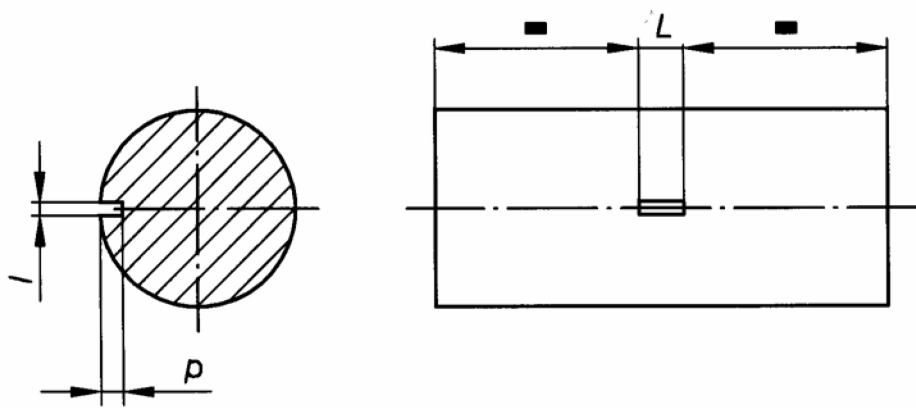


Figure C.2 — Eddy current inspection of roller raceways — Calibrated reference roller

Annex D (normative)

Cages of polymeric material

D.1 Purpose

This annex describes the material for polymeric cages and the requirements for the cages manufactured from this material by injection moulding and the procedure to test the mechanical properties of these cages.

D.2 Material

D.2.1 General

The properties of the polymer material shall be such that the cage can meet the requirements as defined in the customer specification (Clause 4) as well as the performance rig test according to EN 12082. The polymer material also needs to withstand exposure to lubricating greases and oils used during the life cycle of the bearing.

D.2.2 Base material

Polyamide (PA), glass-fibre reinforced, heat resistant grade.

The polyamide to be applied is preferably PA66 or PA6. The preferred level of glass-fibre reinforcement is approximately 25 %. Other materials as high temperature polymeric materials may be used after agreement. The use of recycled materials is not permitted.

D.2.3 Additives

Additives (such as stabilizers, auxiliary materials, plasticizers, fillers, reinforcements and colouring materials) shall be equally distributed throughout the plastic material. Manufacture-induced variations and orientations in terms of material quality and distribution of additives shall be permitted, provided they do not affect the approval of the polymeric cages. The PA polymer may contain specific elastomeric components to increase its toughness. Such compounds are known as "super tough" or "toughened" PA.

D.2.4 Conditioning

Conditioning shall be performed at the cage manufacturer.

D.3 Cage requirements

D.3.1 Inspection plan

D.3.1.1 General

Samples from the polymeric cages shall be taken from suitable points that are deemed critical from an injection moulding perspective, such as the area connecting to the cage bar, areas with maximum wall thickness or material agglomerations. At least one sample shall be taken from one cage.

Table D.1 — Requirements and test method for base polymers

| Material | | | | |
|---|---|---|--------------|------------------|
| Property | Requirements | Test | For approval | For series |
| Moisture content after conditioning | 1 – 2.5 % | D.4.2 | Yes | Yes ^c |
| Chemical composition (base polymer) | ^d | ^a | Yes | once per batch |
| Melting point | ^d ±5 [°C] | EN ISO 11357-3 | Yes | Yes ^b |
| Viscosity index | ^d ± 25 [cm ³ /g] Solvent: formic acid 90 % or sulphuric acid 96 % | EN ISO 307 | Yes | Yes ^b |
| Density | ^d ±0.025 g/cm ³ | EN ISO 1183-1 or EN ISO 1183-2 | Yes | Yes ^b |
| Fillers | | | | |
| Property | Requirements | Test | For approval | For series |
| Rate of glass fibres | ^d ± 2.5 % | EN ISO 3451-1 EN ISO 1172 | Yes | Yes ^b |
| Length of glass fibres | 0.1 to 1.0 mm for 95 % of the glass fibres | D.4.3 | Yes | No |
| Diameter of glass fibres | 12 ± 3 µm on average value of measurements | D.4.3 | Yes | No |
| Mechanical tests for injection approval | | | | |
| Property | Requirements | Test | For approval | For series |
| Bending test on cage or Tension test on cage body or Tension test on cage bar | At least 90 % of ^e Method agreed (Clause 4) | D.5 – at least one of these three tests is required See ^f | Yes | Yes ^b |
| Mechanical tests for material approval | | | | |
| Impact strength or Charpy impact strength on the test specimen | ≥ 40kJ/m ² | EN ISO 179-1 See ^f and ^g | Yes | No |
| Bending strength on the test specimen | ^d ±10% | EN ISO 178 See ^f | Yes | No |
| Thermal ageing in grease or oil bath | To be performed at customer's request (Clause 4) | D.5 | Yes | No |
| Visual inspection | | | | |
| Property | Requirements | Test | For approval | For series |
| Sub-surface quality | see D.3.5 | D.4 | Yes | Yes |
| Surface quality | see D.3.4 | D.3.4.2 | Yes | Yes |

^a Suitable methods such as thermal analysis, infrared spectroscopy or gas chromatography are used to identify and determine the chemical composition and the components of the material used for the polymeric cage.

^b Inspection frequency according to D.3.1.2.

^c Inspection frequency is minimum two samples per batch or annually, to be agreed according to Clause 4.

^d Material data sheet from the cage material supplier documented in accordance to Clause 4.

^e Reference established either on the initial samples (new cage) or on existing parts for cage already produced. documented in accordance to Clause 4.

^f Sample moisture content < 0.1 % according to D.3.2.

^g Separately manufactured test specimens using the same granulate batch may be used if the cage to be tested does not provide sufficient material to test according to EN ISO 179-1.

D.3.1.2 Inspection frequency for series production

The inspection frequency shall be based on the batch size, i.e. for a batch size of $\leq 5,000$ cages two cages each at 10 %, 50 % and 100 % of the batch size $> 5,000$ two cages each at 10 %, 30 %, 50 %, 70 % and 100 % of the batch. Inspections shall be performed on finished polymeric cages and shall be documented in a test log.

The test log shall as a minimum contain the following data:

- Designation (material/cage design);
- Date of manufacture;
- Quantity;
- Order number;
- Batch number;
- Test results.

D.3.2 Moisture content

The total moisture content is determined on a cut-out cage bar. For this purpose, at least two samples shall be taken from opposite sides of the cage. Alternative option: use entire cage.

Unless another method has been agreed, specimens shall be dried for 96 hours in a vacuum furnace at an air pressure of approx. 250 mbar and a temperature of 110 °C or for 24 hours at 120 °C. In case of disputes, drying for 96 hours at 110 °C and approx. 250 mbar is required (see EN ISO 179-1).

The moisture content shall be measured in terms of the percentage loss of mass determined. A desiccator shall be used for cage water content measurement on samples.

D.3.3 Fibre glass diameter and length measurement procedure

Fibre glass measurement shall be done after calcination.

Material tested:

- Sample taken on cage;
- Quantity: approximately 2 g.

Measurement:

- By optical means with magnification;
- x100 for length;
- x200 for diameter.

A minimum of 20 measurements for diameter and length shall be performed.

D.3.4 Surface quality

D.3.4.1 General

The manufacturer shall create and maintain a defect catalogue to define the acceptance limit for below visual defects:

- mechanical damages (e.g. from improper handling);
- uniform surface appearance;
- flow marks;
- surface roughness and open pores;
- glass fibres protruding from the surface; or visible in the top surface skin;
- height of burrs (see below).

D.3.4.2 Surface defects

Inspection conditions shall comply with EN 13018.

D.3.4.3 Burrs

Measurement shall be done with an appropriate measuring device. Using a profile projector is recommended. Acceptance criteria shall be:

- No burrs are accepted in functional areas that can come into contact with the rolling elements or raceways;
- Burrs on parting lines shall not exceed 0.2 mm;
- Outer edges shall be designed to have chamfers or shall be rounded and shall be free from protruding burrs;
- The maximum permitted height of burrs shall not exceed 0.2 mm outside of functional areas.

D.3.5 Sub-surface quality

Severe voids in form of cracks as a result of flow marks are not allowed. Voids smaller than 0.2 mm are allowed. Voids larger than 0.2 mm are not permitted within a section of 1 mm below the surface. Below this zone, voids of the following sizes are permitted (see Figure D.1 — a and b > 1 mm, $L/E \leq 10\%$, $L \leq 1$ mm):

- E is the length of the segment along the maximum extension L of the void;
- a and b are the distances from the void in the normal direction of the section surface;
- voids with a size $L \leq 1$ mm provided that $L/E \leq 10$;
- void clusters on the fracture surface are permitted if the fracture strength is higher than 105 % of the specified reference value from the first article inspection;
- if the fracture strength is less than 105 % of the specified reference value from the first article inspection void clusters on the fracture surface of no more than three voids of a size between 0.2 mm to 1.0 mm are permitted, provided the distance between the individual voids exceeds 0.2 mm.

The inspection for voids shall be performed on the fracture surfaces of the cages (fracture test), either on those units which are submitted to the fracture test on the tensile tester or on units taken from the ongoing manufacturing process and broken intentionally (at points of maximum wall thickness or material agglomerations).

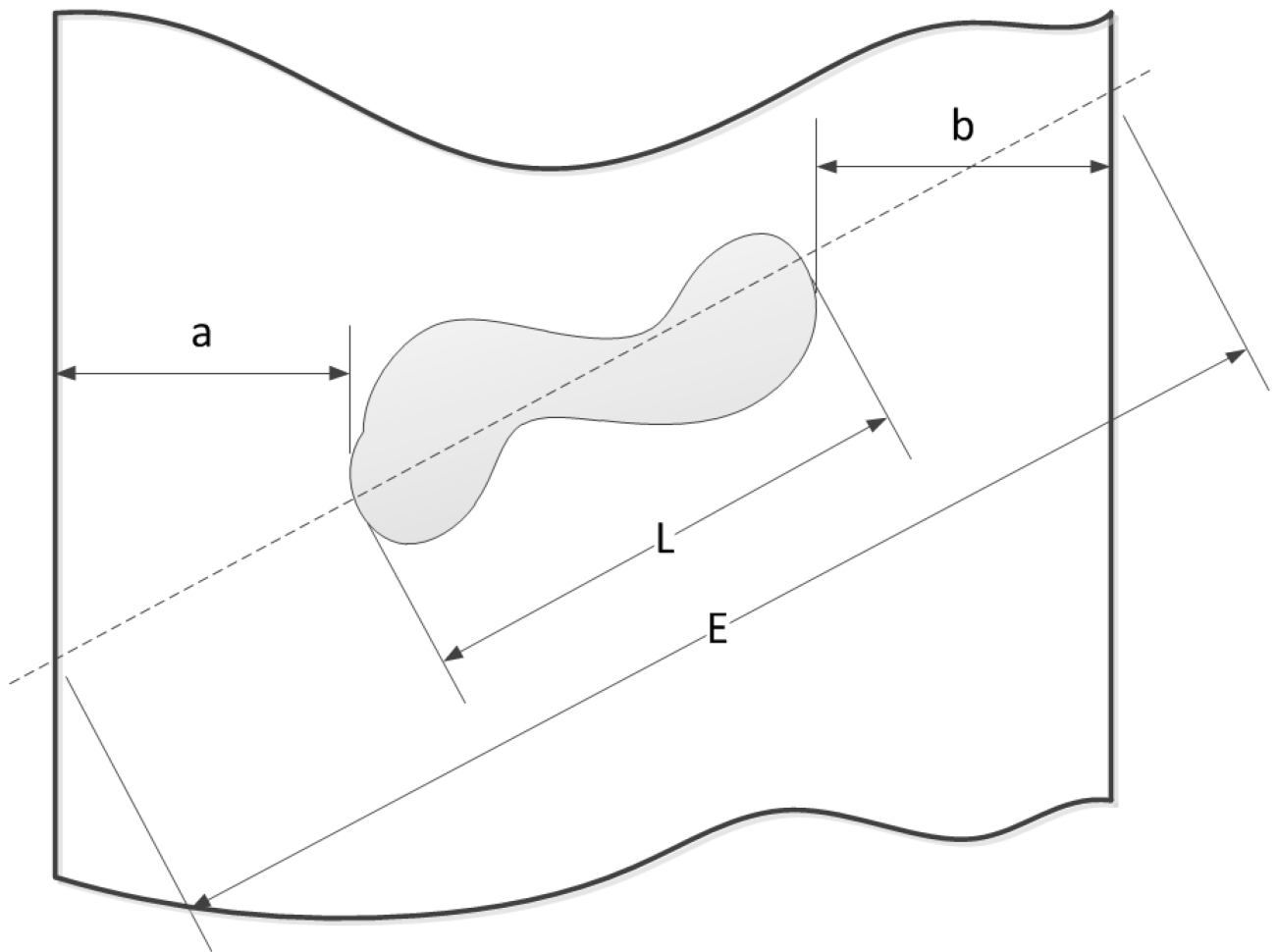


Figure D.1 — a and $b > 1$ mm, $L/E \leq 10$ %, $L \leq 1$ mm

Sub surface inspection shall be performed on every tested cage according to D.4.2 or D.4.3. In case of multiple breakages, at least the initial breaking point shall be inspected. Magnifying means should allow void measurement greater than 0.2 mm. Magnifying range should be at least x6.

D.4 Mechanical tests

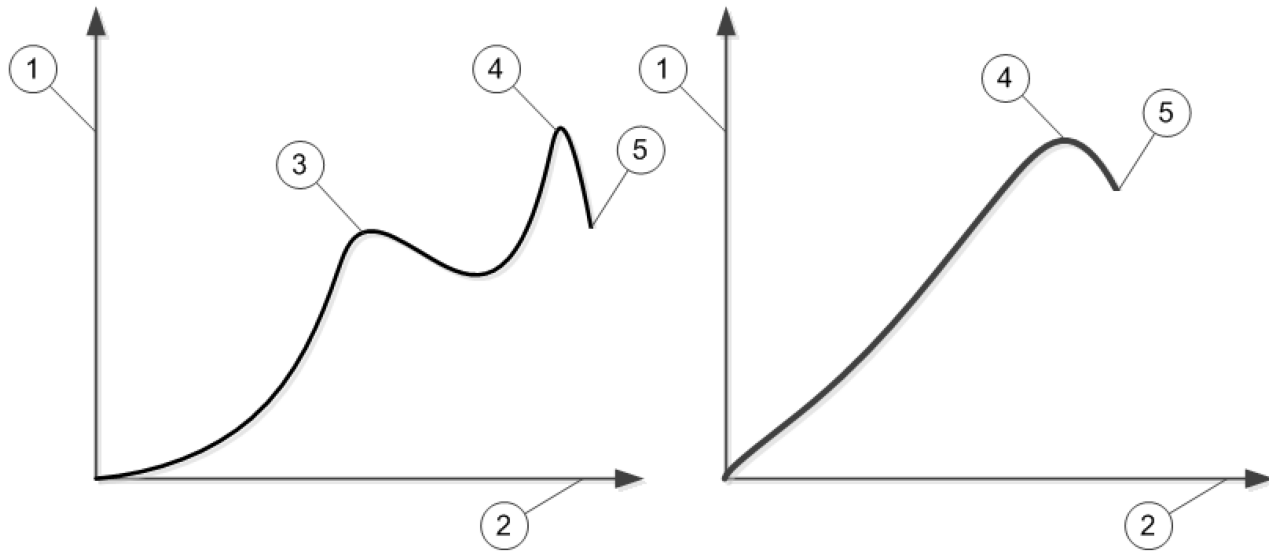
D.4.1 Test conditions

Selection of one or more of the testing methods in D.4.2 and D.4.3 is to be decided by agreement between customer and manufacturer according to Clause 4.

The following test conditions shall be respected:

- Testing at ambient temperature, and/or at a different temperature on customer demand;
- Test to be performed on new cages never mounted;
- Minimum of five cages shall be used. For this purpose, the bridges/bars from the same position of all cages shall be tested by using an angular reference for cage position. This angular reference shall be a reference mark made by injection (ex: date stamp, cage reference, brand name, see Figure D.3 — Test arrangements for bending test);

- Loading of the cage should be positioned such that the most critical area (material agglomerations) or section is tested. The orientation of the test specimen during the first article inspection shall be documented and maintained unchanged for series production;
- For breakage load measurement, either initiation of breakage (3) or breakage load (4) should be used. The test report should specify which point is used (see Figure D.2 — Breakage load).



- Key**
- 1 load [N]
 - 2 displacement [mm]
 - 3 initiation of breakage
 - 4 peak load = breakage load
 - 5 breakage

Figure D.2 — Breakage load

D.4.2 Bending test procedures

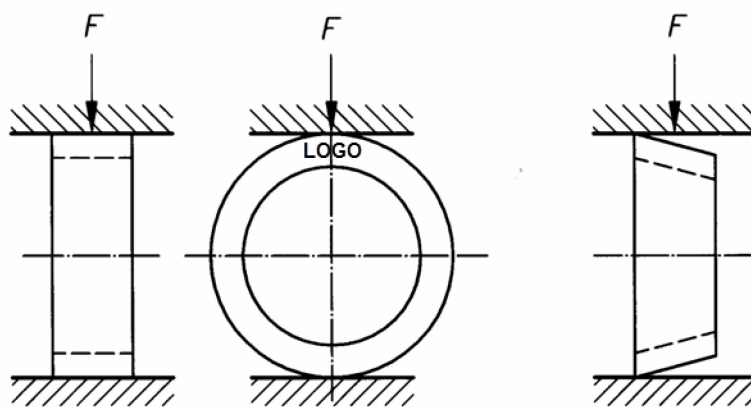
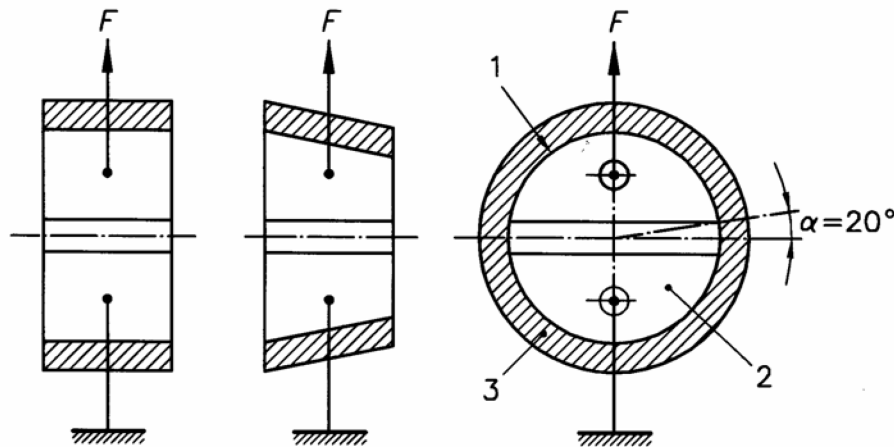


Figure D.3 — Test arrangements for bending test

The test arrangements are shown in Figure D.3 — Test arrangements for bending test. The cage is loaded till fracture at a deformation speed of 5 - 200 mm/min²). The force F in newtons, leading to fracture is the cage fracture bending strength. No specific tool is required. Bending is done between two parallel, rigid and flat surfaces.

D.4.3 Tension test procedures

D.4.3.1 Force applied to cage body



Key

- 1 radius of tool (2) = radius of cage (3)
- 2 tool (the value of $\alpha = 20$ deg is to ensure sufficient contact area between cage and tool)
- 3 cage (shown with hatched section)

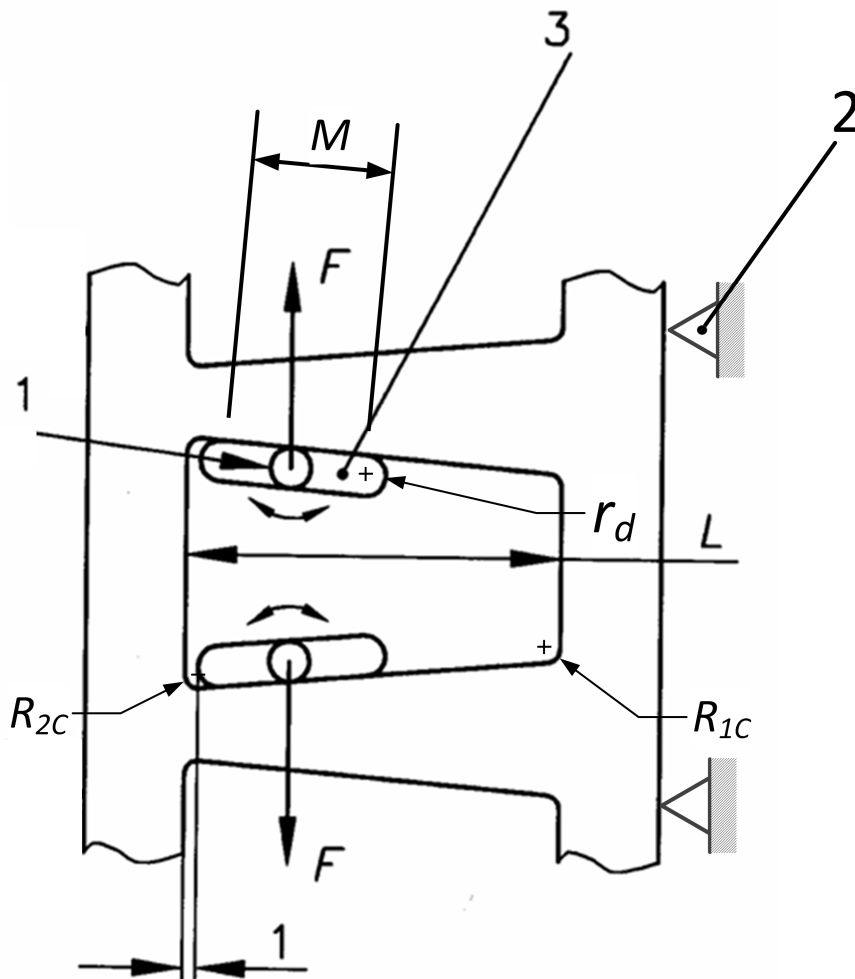
Figure D.4 — Test arrangements for tension test

The test arrangements are shown in Figure D.4 — Test arrangements for tension test. The cage is loaded till fracture at a deformation speed 5 to 10 mm/min³). The force F in newtons, leading to fracture is the cage fracture tension strength.

2) A higher deformation speed leads to a wider spread of measurements. For this reason - a maximum speed of 200 mm/min is recommended.

3) A higher deformation speed leads to a wider spread of measurements. For this reason - a maximum speed of 10 mm/min is recommended.

D.4.3.2 Force applied to cage bar



Key

- | | | | |
|-----|--|----------|------------------------------------|
| 1 | self-aligning arrangement of pull device | M | length of pull device |
| 2 | support | r_d | radius of pull device |
| 3 | pull device | R_{2c} | radius of cage pocket (left side) |
| F | test force | R_{1c} | radius of cage pocket (right side) |
| L | cage pocket length | | |

Figure D.5 — Test arrangement for tension test of TRB cage

For Taper Roller Bearings (TRB) the test arrangement is shown in Figure D.5 — Test arrangement for tension test of TRB cage; the cage shall be guided by supports (2) on the right side of the testing device. Forces (F) are applied by means of pull devices, which are positioned so that there is no contact between the pull device and the side ring but maximum at 1 mm distance from the inner left-hand side face of the cage pocket as indicated in Figure D.5 — Test arrangement for tension test of TRB cage.

For Cylindrical Roller Bearings (CRB) the test arrangement is shown in Figure D.6 — Test arrangement for tension test (CRB). Forces (F) are applied by means of pull devices, which are centred in the cage pocket as indicated in the figure.

The pull devices are defined as follows:

- r_d shall be equal to the nominal value of the cage pocket radius (R_{2c} . For TRB, R_c for CRB);

- for TRB cages the length in contact with the cage (M) shall be equal to 60 (+/- 5) %, of the total nominal roller length;
- for CRB cages the length in contact with the cage (M) shall be equal to 80 (+/- 5) %, of the total nominal roller length.

The cage bars are loaded till fracture. The force (F) in newtons leading to fracture is the cage fracture tension strength.

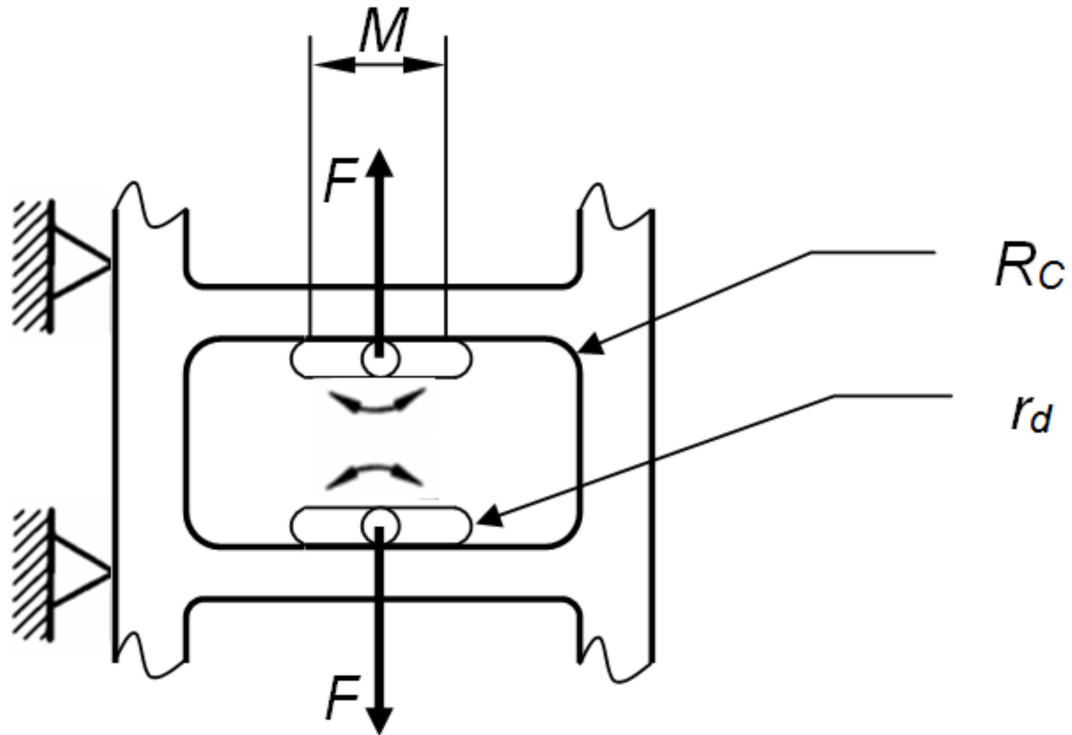


Figure D.6 — Test arrangement for tension test (CRB)

D.5 Thermal ageing in grease or oil bath

Mechanical tests for material approval shall be repeated after ageing of the specimen in the grease to be used (see test procedure D.4.1).

Recommended procedure and test requirements:

- 1 000 h at 140 °C;
- Material batch used for compatibility test shall be representative of mass production and could be different from the material batch used for part approval;
- Fracture strength loss ≤ 50 % (bending or tension test);
- Shock resistance loss ≤ 60 % (impact strength test).

The test conditions and acceptance criteria shall be in accordance with the technical specification according to Clause 4.

Annex E (normative)

Approval procedures

E.1 General

The type of approval applicable to the rolling bearings in question shall be in accordance with the technical specifications as defined in Clause 4.

NOTE Usually the customer specifies the type of approval applicable.

- complete approval, type C; corresponding to a complete procedure as specified in E.2;
- reduced approval, type R; corresponding to a reduced procedure as specified in E.3.

E.2 Complete procedure, type C

E.2.1 General

The type C rolling bearing approval procedure consists of four successive stages.

E.2.2 Stage 1

Interface and detailed drawings shall be documented in the technical specification as defined in Clause 4.

NOTE 1 Usually the customer provides the interface drawings and the manufacturer the detail drawings.

The product specification shall detail separately the following:

- performance of the rolling bearing for a given application in accordance with ISO 281;
- type of materials used (designation, manufacturing);
- type of heat treatments.

NOTE 2 Usually the manufacturer specifies these data.

E.2.3 Stage 2

The material characteristics, the steel metallurgical characteristics (cleanliness, heat treatment, etc.) and the physical, mechanical and geometric properties of the rolling bearing shall be verified as meeting the technical specification.

NOTE Usually the customer performs the verification.

E.2.4 Stage 3

If the rolling bearings comply with the specifications above, a rig performance test representing service conditions shall be carried out in accordance with EN 12082.

E.2.5 Stage 4

Field tests shall be carried out on vehicles in service, using a representative sample of rolling bearings, produced according to mass production conditions. Before the test, the rolling bearings shall be inspected; results shall be recorded. Depending on the operating conditions of the vehicles for which the rolling bearings are intended, the test period and number of bearings to be tested shall be as defined in EN 12082.

NOTE Usually these tests are carried out by the customer.

E.2.6 Decision

The approval of a rolling bearing shall be granted when:

- technical documents have been approved;
- characteristics conform to those laid down in this European Standard and those indicated on the various documents submitted;
- rig performance tests have been successful;
- service tests reveal no abnormality, which can be directly attributed to the bearings tested.

E.3 Reduced procedure, type R

The type R rolling bearing approval procedure shall depend on the degree of novelty based on Annex F.

NOTE Usually the customer specifies which stages are to be used.

Annex F (normative)

Criteria to determine the extent of approval procedures

The extent of the procedures to be used for the approval depends on the degree of novelty of the axlebox assembly and its components with respect to proven operation performance.

There are two procedures, type C (Complete), and type R (Reduced), for the rolling bearings described in this European Standard and for the lubricating greases described in EN 12081.

The complete approval procedure, type C, complies with E.2 and follows the requirements of EN 12082.

The reduced approval procedure, type R, is as defined in the technical specification, as stated in E.3.

NOTE 1 Usually the customer specifies which stages are to be used.

NOTE 2 Where the effect of any product changes – without any influence on temperature or reduction of bearing life – can be demonstrated either by detailed component or material testing or by proven performance in other comparable bearing applications, then a type R approval procedure can be agreed between customer and manufacturer.

For the rolling bearings, all new designs, significant changes of the internal design or of material, metallurgical process and heat treatment as well as significant changes of the application requires the type C procedure. Table F.1 describes in detail the criteria for the selection. The changes are classified in three risk groups.

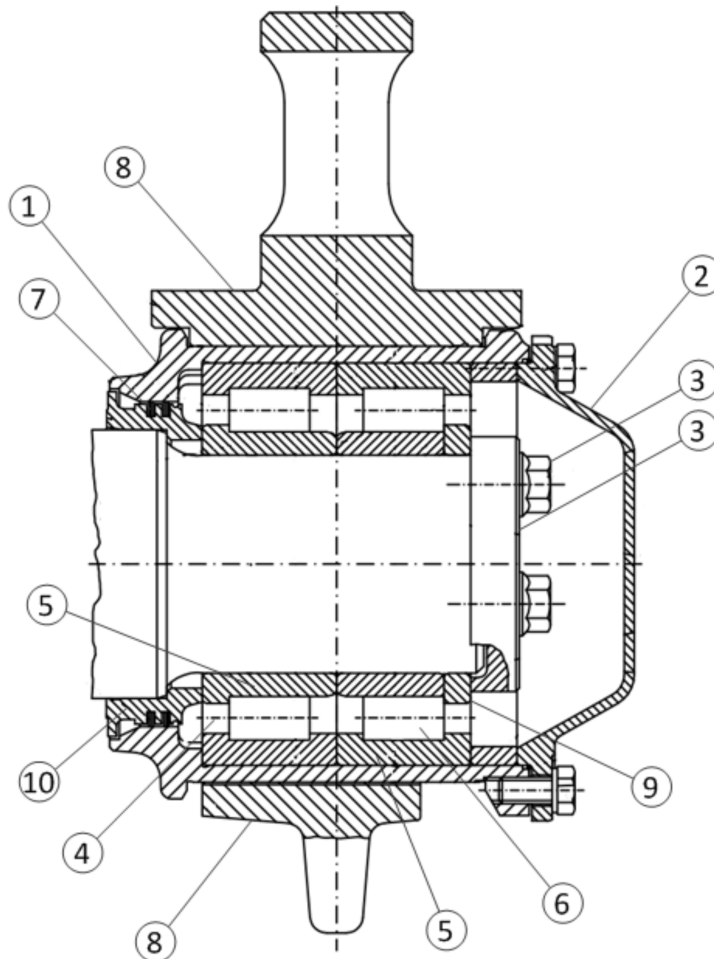
- a) **Risk group 1** — Any change beyond the operationally proven performance range will significantly affect operating temperature or life. In this case, a type C procedure is carried out.
- b) **Risk group 2** — Any change beyond the operationally proven performance range may affect operating temperature and life, increasing with the extent of change. The selection of the type C or type R procedure is agreed between the customer and the manufacturer.
- c) **Risk group 3** — Any change beyond the operationally proven performance range may affect operating temperature, but have little effect on life. Here, a type R procedure will be carried out with details to be agreed between the customer and the manufacturer.

Table F.1 — Criteria to determine the extent of approval procedures of axlebox rolling bearings

| Risk group | Element of change | Change requiring a new approval (in relation to proven operational performance) | Approval type | |
|---|--|--|---------------|--------|
| 1 | Design | | | |
| | Bearing design | New bearing design or new basic bearing | C | |
| | Design details: — Internal geometry — Roller and cage guidance — Material | Significant change to the parameters below: — Modification of raceway and/or roller — Change of principle of guidance — Significant change of material, rings, rollers or cages | | |
| | Manufacture | | | |
| | Steel processing | Entirely new metallurgical process | | C or R |
| | Heat treatment | New process for rings or rollers | | |
| 2 | Design | | | |
| | Bearing size | ≥ 10 % change in size of bore diameter or outside diameter | C or R | |
| | Cage design | Different geometry | | |
| | Sealed bearings | Change of grease and/or changes of seal type excluding holes for sensors | | |
| | Manufacture | | | |
| | Manufacturing process | Major change of procedures for components | C or R | |
| | Metallurgy | Minor change of metallurgy or heat | | |
| | Factory | Change of manufacturing plant | | |
| | Manufacturers sub- | New sub-contractor for rings, rolling | | |
| | Application | | | |
| Operational mass under normal payload according to | more than 10 % increase compared to reference mass for which the bearing is | C or R | | |
| 3 | Design | | | |
| | Bearing size | < 10 % change in size of bore or outside diameter | R | |
| | Application | | | |
| | Interfaces ^a | Any change of tolerances / fits | | |
| | Internal clearance | Any change of nominal clearance in service | | |
| | Ambient temperature | more than 20 °C change of maximum / minimum ambient temperature | | |
| | Maximum speed | Any increase of maximum rotational speed | | |
| | Lubrication | more than 20 % change of grease quantity | | |
| ^a If the bearing interfaces are affected to a degree outside the limits of A.9.2 of EN 12082, a risk group 3 approval process may be required. | | | | |

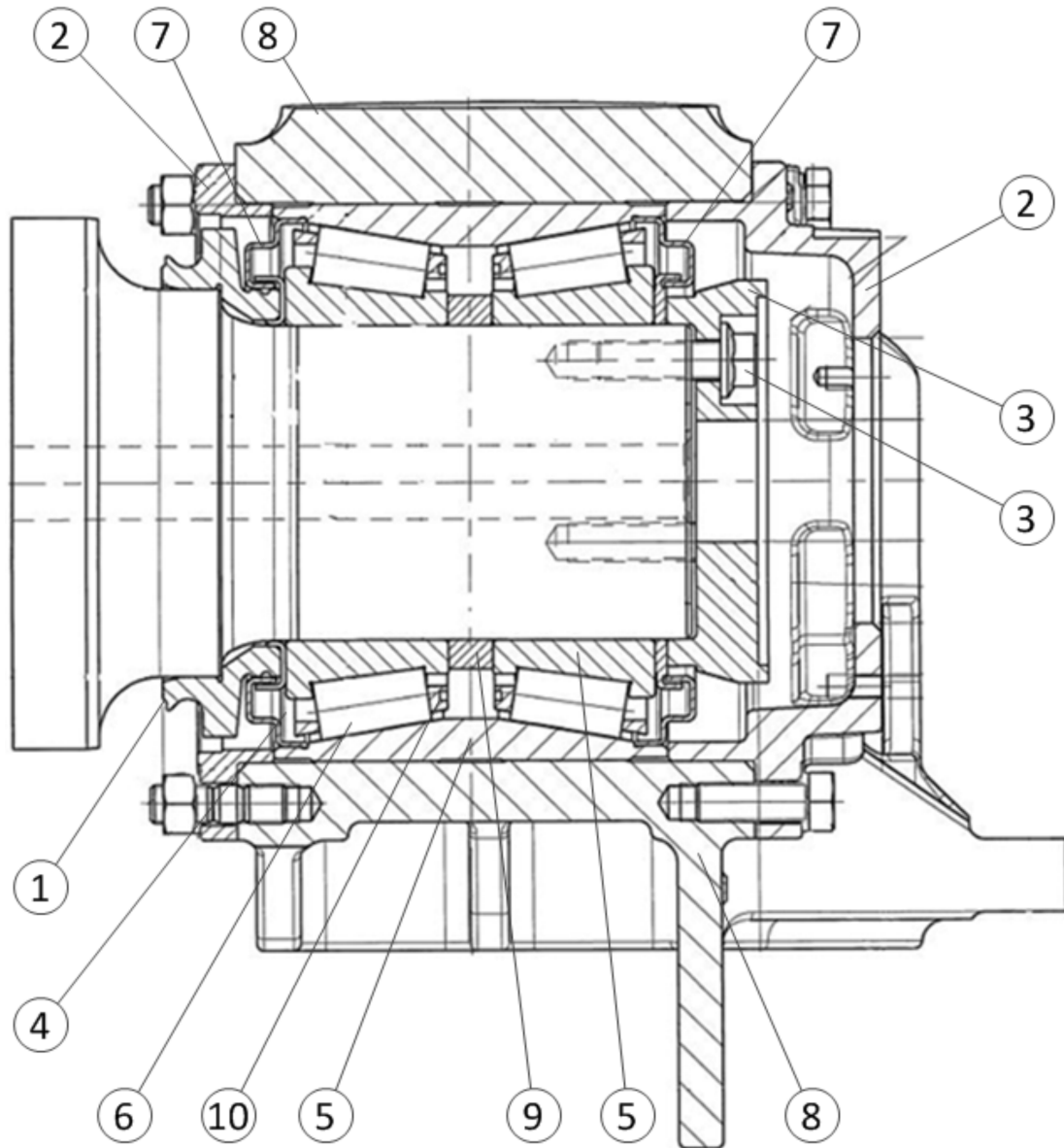
Annex G
(informative)

Examples of axlebox assemblies



| Pos. | Description (English / German / French) | Pos. | Description (English / German / French) |
|------|---|------|--|
| 1 | bearing sleeve / Gehäusering / fourreau | 6 | rolling elements / Wälzkörper / corps roulants |
| 2 | housing cover / Gehäusedeckel / couvercle de corps de boîte | 7 | seal / Dichtung (hier: fey-lamellenringe) / joint |
| 3 | axle end cap components / Komponenten des Wellenverschlusses / composants de chapeau de fusée | 8 | box housing / Lagergehäuse / Corps de boîte |
| 4 | rolling bearing / Wälzlager/ Roulement | 9 | ribs and thrust collars / Bordscheiben und Winkelringe / Collet rapporté - |
| 5 | ring / Ring / bague | 10 | backing ring / Labyrinthring (Stützring) / collettere arrière |

Figure G.1 — Example of axlebox assembly with a set of cylindrical roller bearings



| Pos. | Description (English / German / French) | Pos. | Description (English / German / French) |
|------|---|------|---|
| 1 | backing ring / Labyrinthring (Stützring) / collerette arrière | 6 | rolling elements / Wälzkörper / corps roulants |
| 2 | housing cover / Gehäusedeckel / couvercle de corps de boîte | 7 | seal / Dichtung / joint |
| 3 | axle end cap components / Komponenten des Wellenverschlusses / composants de chapeau de fusée | 8 | box housing / Lagergehäuse / Corps de boîte |
| 4 | cartridge bearing / Wälzlagerereinheit / roulement cartouche | 9 | distance ring / Abstandsring (distanzring) / entretoise centrale |
| 5 | ring / Ring / bague | 10 | cage / Käfig / cage |

Figure G.2 — Example of axlebox assembly with a cartridge bearing

Annex ZA (informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC aimed to be covered

This European Standard has been prepared under a Commission's standardization request M/483 to provide one voluntary means of conforming to the essential requirements of the Directive 2008/57/EC on the interoperability of the rail system (recast).

Once this standard is cited in the Official Journal of the European Union under that Directive 2008/57/EC, compliance with the normative clauses of this standard given in Table ZA.1 for freight wagons, and Table ZA.2 for locomotive and passenger RST confers within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 – Correspondence between this European Standard, , EU Regulation 321/2013 of the Commission dated 13 March 2013 relative to the technical interoperability specification relating to the sub-system “rolling stock – freight wagons” for rail systems within the European Union, abrogating Decision 2006/861/EC (published in JOUE L 104, 12.4.2013, p.1) and Directive 2008/57/EC

| Clause/ sub-clauses of this European Standard | Chapter/§/annexes of the TSI | Corresponding text, articles/§/annexes of the Directive 2008/57/EC | Comments |
|---|--|---|----------|
| The whole standard is applicable. | 4.Characterisation of the subsystem 4.2 Functional and technical specifications of the subsystem 4.2.3 Gauging and track interaction 4.2.3.6. Running gear 4.2.3.6.5. Axle boxes/bearings 6. Conformity assessment and EC verification 6.2. Subsystem 6.2.2. EC verification procedures 6.2.2.4. Axle box/bearings | Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.3 1.2 Reliability and availability 2 Requirements specific to each subsystem 2.4 Requirements specific to each subsystem «Rolling stock» 2.4.2 Reliability and availability | |

Table ZA.2 – Correspondence between this European Standard, the Commission regulation °1302/2014 of 18 November 2014 concerning the technical specification for interoperability relating to the ‘rolling stock locomotives and passenger rolling stock’ of the rail system in the European Union (published in the Official Journal L 356, 12.12.2014, p.228) and Directive 2008/57/EC”

| Clause/ sub-clauses of this European Standard | Chapter/§/annexes of the TSI | Corresponding text, articles/§/annexes of the Directive 2008/57/EC | Comments |
|---|---|---|----------|
| The whole standard is applicable. | 4.Characterisation of the Rolling stock subsystem 4.2 Functional and technical specifications of the subsystem. 4.2.3 Track interaction and gauging. 4.2.3.5. Running gear § 4.2.3.5.2. Wheelsets 4.2.3.5.2.1. Mechanical and geometric characteristics of wheelsets § Mechanical behaviour of the axle boxes 6. Assessment of conformity or suitability for use and 'EC' verification 6.2 Rolling stock subsystem 6.2.3 Particular assessment procedures for subsystems 6.2.3.7 Mechanical and geometric characteristics of wheelsets § Axle boxes/bearings | Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.3 1.2 Reliability and availability 2 Requirements specific to each subsystem 2.4 Requirements specific to each subsystem «Rolling stock» 2.4.2 Reliability and availability | |

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the products falling within the scope of this standard.

Bibliography

- [1] ASTM E975-13, *Standard Practice for X-Ray Determination of Retained Austenite in Steel with Near Random Crystallographic Orientation*
- [2] EN 10247, *Micrographic examination of the non-metallic inclusion content of steels using standard pictures*
- [3] EN ISO 2039-1, *Plastics - Determination of hardness - Part 1: Ball indentation method (ISO 2039-1)*
- [4] EN ISO 6721-1, *Plastics - Determination of dynamic mechanical properties - Part 1: General principles (ISO 6721-1)*
- [5] EN ISO 9001, *Quality management systems - Requirements (ISO 9001:2015)*
- [6] EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712)*