INTERNATIONAL STANDARD

ISO 13411

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Aerospace — Airframe needle roller, cylindrical roller and track roller bearings — Technical specification

Aéronautique et espace — Roulements à aiguilles, roulements à rouleaux cylindriques et galets de came pour cellule d'aéronef — Spécifications techniques

Reference number
ISO 13411:1997(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13411 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 15, *Airframe bearings*.

Annexes A to I form an integral part of this International Standard. Annex J is for information only.

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Introduction

In l986, ISO/TC 4 Rolling bearings approved a new work item to revise the International Standard on airframe bearings, ISO 1002:1983, *Rolling bearings — Airframe bearings — Characteristics, boundary dimensions, tolerances, static load ratings*. The work item was assigned to ISO/TC 4, *Rolling bearings* and TC 20, *Aircraft and space vehicles*, Joint working group on airframe bearings.

Later that same year, ISO/TC 4/TC 20 JWG on airframe bearings agreed that a technical specification for the procurement of airframe bearings should be prepared as part of the revision process.

As a result, ISO 13411:1997, *Aerospace — Airframe needle roller, needle track roller and cylindrical roller bearings — Technical specification* has been developed for the procurement of airframe bearings and is supplemented with International Standards for each bearing type.

Aerospace — Airframe needle roller, cylindrical roller and track roller bearings — Technical specification

1 Scope

This International Standard specifies the required characteristics, inspections and tests, quality assurance and conditions for qualification, static radial loads, acceptance and delivery conditions for needle roller, needle track roller and cylindrical roller bearings used as airframe rolling bearings designed to withstand, under load, slow rotations and small oscillations only.

This International Standard is applicable to all airframe needle roller, needle track roller and cylindrical roller bearings referred to in the referenced International Standards or in a design specification.

The fact that a bearing is not included in this International Standard does not preclude it from being used to advantage in airframe applications.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1132:1980, *Rolling bearings — Tolerances — Definitions.*

ISO 2859-1:—[1)], *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture.*

ISO 5593:1997, *Rolling bearings — Vocabulary.*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method.*

ISO 6508:1986, *Metallic materials — Hardness test — Rockwell test (scales A- B- C- D- E- F- G- H- K-).*

ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*

ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing.*

ISO 9003:1994, *Quality systems — Model for quality assurance in final inspection and test.*

[1)] To be published. (Revision of ISO 2859-1:1989)

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 5593 apply. Definitions of the concepts to which the tolerances specified in this International Standard apply are given in ISO 1132. Additional definitions which are particular to airframe needle roller bearings are given in 3.1 to 3.9.

3.1 yoke type track roller bearings
full complement bearings with outer ring rolling on a track or cam track

3.2 yoke type roller bearings
full complement bearings with outer ring supported in a housing

3.3 stud type track roller bearings
full complement bearings with rolling elements running on a flanged and externally threaded stud, and with outer ring rolling on a track or cam track

3.4 sealed bearings
bearings in which the rolling elements and raceways are enclosed by contact seals (i.e. seals fitted to one ring and extending to the other ring with which they make sliding contact)

3.5 shielded bearings
bearings in which the rolling elements and raceways are enclosed by shields fitted to one ring and extending to the other ring with which they have a small clearance

3.6 surface discontinuities
imperfections which include (but are not limited to) the following:

3.6.1 crack
break in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character

3.6.2 tool mark
open surface defect resulting from a tearing of the metal

3.6.3 lap
surface defect where particles of metal or sharp edges are folded over and then rolled or forged into the surface

3.6.4 seam
unwelded fold which appears as an open defect in the material

3.7 starting friction torque for track roller bearings
maximum torque required to start the rotation of the outer ring with the inner ring or stud held stationary

3.8 starting friction torque for housed roller bearings
maximum torque required to start the rotation of the inner ring with the outer ring held stationary

NOTE — Due regard should be given the fact that bearings without retainers or separators are not likely to have absolute freedom of rotation because of adjacent rolling elements rubbing each other.

3.9 Permissible static loads

3.9.1 permissible static radial load
maximum static radial load which can be applied to the bearing without impairing its subsequent operation

3.9.2 ultimate static radial load
maximum static radial load which can be applied to the bearing without causing cracks or ruptures in any of the component parts

NOTE — The ultimate static radial load is a load equal to 1,5 times the permissible static radial load.

4 Symbols

See the appropriate referenced International Standard.

5 Characteristics, requirements, inspection and test methods

Subclause	Characteristics	Requirements	Inspection and test methods	Q[1]	A[1]
5.1	Materials	Shall conform to product standards or design documentation.	Chemical analysis or certificate of conformity issued by the manufacturer.	X	X
5.2	Dimensions and tolerances				
5.2.1	At ambient temperature (20 °C ± 1 °C)	Shall conform to product standards or design documentation.	Suitable measuring instruments.	X	X
5.2.2	Dimensional stability	Permissible increase 0,1 µm max. per 1 mm of diameter.	See annex B.	X	
5.3	Mass	Shall conform to product standards or design documentation.	Suitable methods.	X	
5.4	Identification marking	Shall conform to product standards or design documentation. It shall be legible and shall not adversely affect the material or the functioning of the bearing.	Visual examination.	X	X
5.5	Surface appearance [2]	The bearings shall be free of surface discontinuities liable to have an adverse effect on characteristics and endurance.			
5.5.1	Unassembled rings and rolling elements		Magnetic, dye penetrant or eddy current inspection.	X	X
5.5.2	Assembled bearings		Visual inspection using suitable methods.	X	X
5.6	Hardness [2]	Shall conform to product standards or design documentation.	Test in accordance with ISO 6508 or ISO 6507-1 [3]. Inner ring, outer ring and 3 rollers shall be tested. The test shall be on the ground and polished flat cross-sectional area of the rings adjacent to the raceways. Test shall be taken on a ground and polished flat surface on the rolling elements.	X	X
5.7	Surface roughness [2]	Shall conform to product standards or design documentation.	Test in accordance with ISO 4288.	X	X
5.8	Surface treatment	Shall conform to product standards or design documentation.	Visual inspection (plating).	X	X
5.9	Lubrication	At least 80 % of the free space in the bearing shall charged with the grease specified in the product standard or design documentation (see annex I).	Visual inspection after removal of seals or shields.	X	
			Visual inspection during manufacture.		X

1) Q = Qualification tests A = Acceptance tests

2) This inspection is made in the absence of surface treatment which, for purposes of qualification, may be removed by a chemical process.

3) Conversion from Vickers hardness to Rockwell hardness readings shall be subject to agreement between customer and supplier.

Subclause	Characteristics	Requirements	Inspection and test methods	Q[1)]	A[1)]
5.10	Seals or shields				
5.10.1	Retention	The seals or shields shall be fitted correctly in such a way that the functioning of the bearing is not adversely affected.	Visual inspection.	X	X
5.10.2	Sealing	The seals shall:			
		— retain the grease;	Visual inspection after the rings are manually turned in relation to each other.	X	X
		— minimize the penetration of foreign material.	See annex A.	X	
		After the test, the starting torque at zero load shall not increase by more than 100 % or 14,1 mN·m over the pre-test value, whichever is greater.	Suitable method.	X	
		After the test, the radial internal clearance shall not increase by more than 50 % or 5 µm, whichever is greater.	See annex D, figures D.1 and D.2.	X	
		After the test, the running behaviour of the bearings shall conform with 5.14.1.	Hand rotation.	X	
5.11	Running accuracies: Radial – K_{ia}, K_{ea}	Shall conform to product standards or design documentation.	See annex C.	X	X
5.12	Internal clearances				
5.12.1	Radial internal clearance (G_r)	Shall conform to product standards or design documentation.	See annex D.	X	X
5.12.2	Axial internal clearance (G_a)	Shall conform to product standards or design documentation.	See annexe E.	X	X
5.13	End washer retention	The end washer must not become dislodged or the bearing smoothness lessened perceptibly.	See annex F.	X	X
5.14	Behaviour in rotation				
5.14.1	At ambient temperature (20 °C ± 1 °C)	The bearing shall be capable of being rotated with no tight spots.	Hand rotation.	X	X
5.14.2	At limit temperatures	The starting friction torque shall not increase by more than 100 % of the ambient temperature value at the high temperature limit and shall not increase by more than ten times the ambient temperature value at the low limit temperature. Temperature extremes shall conform to product standards or design documentation.	Suitable method.	X	
5.14.3	Axial clearance under compression load	While under compression the bearing shall have rotational freedom.	See annex G.	X	X
5.15	Static loads				
5.15.1	Permissible static radial load (C_s)	After test there shall be no permanent deformations adversely affecting rotational function. The starting friction torque shall not increase by more than 100 %.	See annex H.	X	
5.15.2	Ultimate static radial load	After test the bearing must rotate by hand. After test there shall be no cracks or ruptures.	See annex H.	X	

1) Q = Qualification tests A = Acceptance tests

6 Quality assurance

6.1 Approval of manufacturer

The manufacturer shall have a quality management programme acceptable to the customer which meets the requirements of the appropriate ISO 9000 series quality management standard.

6.2 Product qualification

6.2.1 The manufacturer shall obtain qualification in accordance with tables 1 and 2.

Qualification shall be obtained for each bearing type and size.

However, qualification

— for a plated bearing applies to a non-plated bearing with the same dimensions and of the same type, made of the same material,

— is acquired for a bearing in the series, based on similarity, if it has been obtained for the size of bearing immediately before and the size of bearing immediately after the bearing in question, based on the range of bearings available in the product standard.

7 Acceptance conditions

7.1 Manufacturer's responsibility

7.1.1 The manufacturer shall have a quality management system acceptable to the customer which meets the requirements of the appropriate ISO 9000 series quality management standard.

7.1.2 The acceptance of a delivery batch shall be in accordance with table 3.

7.2 Customer quality control

7.2.1 The customer may, on acceptance of a delivery batch, proceed to inspect it by using the tests and inspections specified in table 2, in full or in part, to ensure that the items conform to the required quality level and to determine whether the consignment is acceptable.

7.2.2 This inspection may be carried out in the customer's factory or, by agreement, in the manufacturer's factory.

8 Packaging

8.1 The bearing shall be packaged individually so that it will not be damaged during transportation.

8.2 The packaging material in contact with the bearing shall be grease-proof and shall protect against moisture, corrosion, dirt and other harmful substances.

8.3 The following information at least shall be affixed to each individual bearing package:

— manufacturer's name;

— quantity (in the case of rolls of bearings);

— identity block as defined by product standards or design documentation;

— lubrication date.

8.4 The following information at least shall appear on collective packaging intended for transport:

— manufacturer's name and address;

— number of contract or order;

— quantity;

— identity block as defined by product standards or design documentation.

9 Certificate of conformity

All bearings supplied in accordance with this International Standard shall be accompanied by a certificate of conformity issued by the manufacturer.

Table 1 — Non-destructive inspections and tests to be carried out for qualification

Types of inspections and tests[1)]	Defined in subclause	Serial number of inspected samples				
		1	2	3	4	5
Materials	5.1	X	X	X	X	X
Dimensions and tolerances	5.2.1	X	X	X	X	X
Mass	5.3	X	X	X	X	X
Identification marking	5.4	X	X	X	X	X
Surface appearance of assembled bearings	5.5.2	X	X	X	X	X
Surface treatment (plating)	5.8	X	X	X	X	X
Retention of seals and shields	5.10.1	X	X	X	X	X
Radial runout	5.11	X	X	X	X	X
Radial internal clearance	5.12.1	X	X	X	X	X
Axial internal clearance	5.12.2	X	X	X	X	X
Rotational behaviour at ambient temperature	5.14.1	X	X	X	X	X
Rotational behaviour at limit temperatures	5.14.2		X			

1) The order of testing is left to the discretion of the qualification authority.

Table 2 — Destructive inspections and tests to be carried out for qualification

Types of inspections and tests[1)]	Defined in subclause	Serial number of inspected samples				
		1	2	3	4	5
Dimensional stability	5.2.2		X			
Surface appearance	5.5.1				X	X
Hardness [2), 3)]	5.6	X			X	X
Surface roughness [2)]	5.7		X		X	X
Lubrication	5.9			X	X	X
Sealing	5.10.2	X				
End washer retention	5.13	X	X			
Axial clearance under compression load	5.14.3	X	X			
Testing of permissible static radial load	5.15.1			X	X	X
Testing of ultimate static radial load	5.15.2			X	X	X

1) The order of testing is left to the discretion of the qualification authority.
2) Measurements to be carried out in zero load areas.
3) At least three rolling elements from zero load area.

Table 3 — Inspections and tests to be carried out for acceptance

Types of inspections and tests[1)]	Defined in subclause	Sampling plan [2), 3)]
Materials	5.1	Chemical analysis or certificate of conformity issued by the manufacturer
Dimensions and tolerances	5.2.1	0,65 AQL[4), 5)]
Identification marking	5.4	100 %
Surface appearance	5.5.1 — outer rings/studs — inner rings/washers	 100 % (unassembled) 0,65 AQL (unassembled)
Hardness[1)]	5.6	5 pieces/lot (unassembled components) [4), 5)]
Surface roughness[1)]	5.7	5 pieces/lot (unassembled components) [4), 5)]
Surface treatment[1)]	5.8	5 pieces/lot (unassembled components) [4), 5)]
Lubrication	5.9	100 %
Sealing (grease retention)	5.10.2	0,65 AQL
Radial runout	5.11	0,65 AQL[4), 5)]
Radial internal clearance	5.12.1	0,65 AQL[4), 5)]
Axial internal clearance	5.12.2	0,65 AQL[4), 5)]
End washer retention	5.13	0,65 AQL[4), 5)]
Behaviour in rotation	5.14.1	0,65 AQL[4), 5)]
Axial clearance under compression	5.14.3	0,65 AQL[4), 5)]

1) The order is left to the discretion of the acceptance authority. These tests may be carried out at the time of manufacture.

2) For the manufacturer, when the sampling is not 100 %, any defect found in the course of an inspection or test requires this inspection to be extended to 100 %.

3) May vary with the approval of the user or authority responsible for acceptance.

4) Acceptable Quality Level (AQL) is based on inspection level II single sample plan according to ISO 2859-1.

5) Minimum one piece.

Annex A
(normative)

Sand and dust test

A.1 Apparatus

A.1.1 Testing shall be conducted in a closed test chamber approximately 0,6m x 0,6m x 0,6m in size.

A.1.2 The sand and dust shall be coarse, air cleaner test dust[1)] composed of (70 ± 5) % SiO_2 by mass. It shall have the following size distribution by volume:

Size	Volume %
µm	>
1	98,3 to 98,6
2	95,3 to 96,3
3,2	92,8 to 93,6
5	88 to 89
10	77 to 79
20	61 to 64
40	38 to 41
80	10 to 12
120	1,5 to 2,5
200	0

A.1.3 A minimum layer of 25 mm of sand and dust should be maintained on the floor of the chamber.

A.2 Method

A.2.1 Measure the radial internal clearance and the starting friction torque of the test bearings before assembly to the shaft.

A.2.2 Mount the test bearings on a horizontal, rotatable shaft within the chamber located 0,2 m to 0,4 m from the chamber floor. The outer rings of the bearings are held from rotating. Space the bearings a minimum of 75 mm from each other and from the walls of the chamber.

[1)] Available from: Powder Technology, Inc.
P.O. Box 1464
Burrisville, Minnesota 55337
USA

A.2.3 A dust cloud shall be created in the chamber using a suitable means of agitation such that the cloud is of uniform density and the test bearings are not readily visible.

A.2.4 The test shall be conducted by rotating the shaft at three revolutions per minute, at room temperature, and under no load.

A.2.5 Test the bearings for 48 h.

A.2.6 After testing, remove the bearings from the chamber for inspection. Determine the change in the starting friction torque by measuring the as-tested bearings.

A.2.7 Thoroughly clean the bearings by removing the seals or shields, degreasing and oiling. Determine the change in the radial internal clearance by measuring the cleaned, as-tested bearings.

Annex B
(normative)

Dimensional stability test

B.1 Apparatus

Suitable installation for controlling bearing test temperature.

B.2 Method

B.2.1 High temperature dimensional stability test

B.2.1.1 The test shall be conducted with Grease B (synthetic hydrocarbon-type) only.

B.2.1.2 Maintain the bearing at the temperature extreme of (150 ± 5) °C for 100 h and allow it to return to room temperature.

B.2.1.3 The external dimensions of the bearing shall be determined before and after test.

B.2.2 Low temperature dimensional stability test

B.2.2.1 Maintain the bearing at the temperature extreme of (–54 ± 10) °C for 4 h and allow it to return to room temperature.

B.2.2.2 The external dimensions of the bearing shall be determined before and after test.

Annex C
(normative)

Verification of radial running accuracy of assembled bearing

C.1 Apparatus

See the test fixture as shown in figure C.1 for needle roller, needle track roller and cylindrical roller bearings (yoke type) or in figure C.2 for stud type track roller bearings as an example.

C.2 Method

C.2.1 Measurement of radial running accuracy of yoke type needle bearings

C.2.1.1 Mount the bearing onto a tapered test mandrel having a diameter taper between 0,000 1:1 and 0,000 2:1.

C.2.1.2 Position the gauge indicator as close as possible to the centre of the outer ring width.

C.2.1.3 Measure the outer ring runout by rotating the outer ring at least one revolution with the inner ring immobilized.

C.2.1.4 Outer ring radial running accuracy (K_{ea}) is the difference between the largest and smallest gauge readings.

C.2.1.5 Measure the inner ring runout by rotating the inner ring and mandrel together at least one revolution with the outer ring immobilized.

C.2.1.6 Inner ring radial running accuracy (K_{ia}) is the difference between the largest and smallest gauge readings.

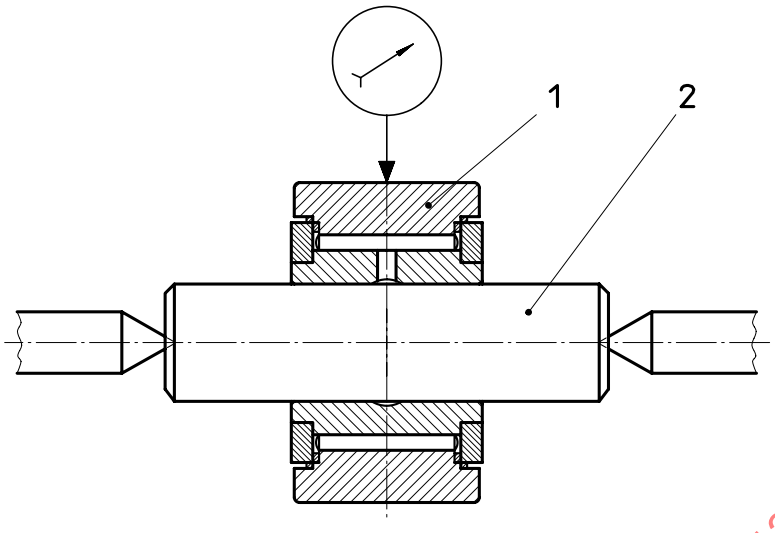
C.2.2 Measurement of radial running accuracy of stud type bearings

C.2.2.1 Mount the bearing in its fixture.

C.2.2.2 Position the gauge indicator as close as possible to the centre of the outer ring width.

C.2.2.3 Measure the outer ring runout by rotating the outer ring at least one revolution with the inner ring immobilized.

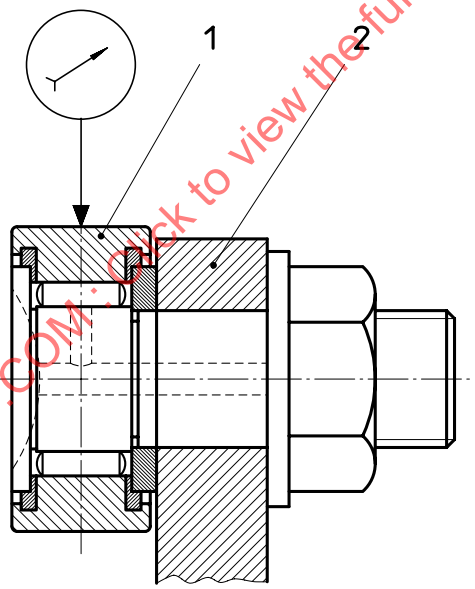
C.2.2.4 Outer ring radial running accuracy (K_{ea}) is the difference between the largest and smallest gauge readings.



Key

1 Bearing under test
2 Tapered mandrel

Figure C.1



Key

1 Bearing under test
2 Rigid support

Figure C.2

Annex D
(normative)

Verification of radial internal clearance in assembled bearing

D.1 Apparatus

See the test fixture as shown in figure D.1 for needle roller, needle track roller and cylindrical roller bearings (yoke type) or in figure D.2 for stud type track roller bearings as an example.

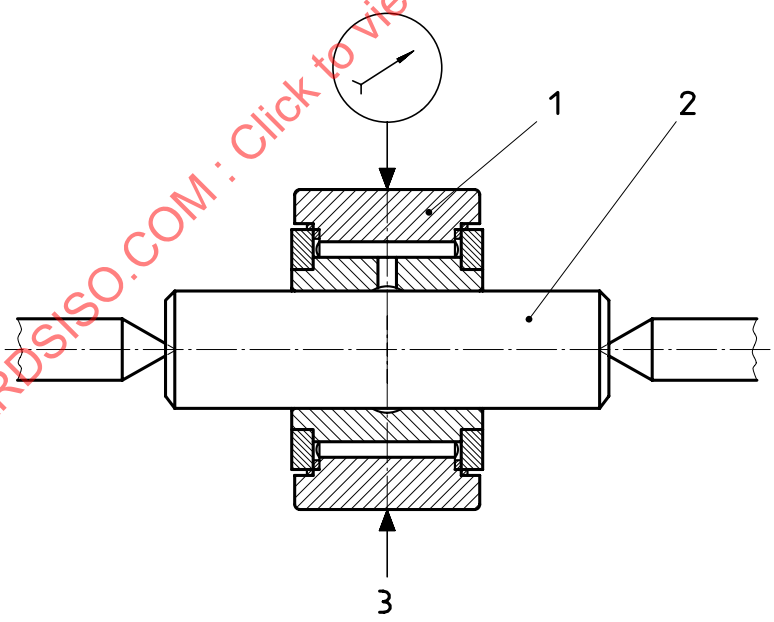
D.2 Method

D.2.1 Mount the bearing. For yoke type bearings, mount the bearing onto a tapered test mandrel having a diameter taper between 0,000 1:1 and 0,000 2:1.

D.2.2 Position the gauge indicator as close as possible to the centre of the outer ring width.

D.2.3 Measure the radial internal clearance by applying a test load of 25 N on the outer ring alternately in one direction and then in the opposite direction.

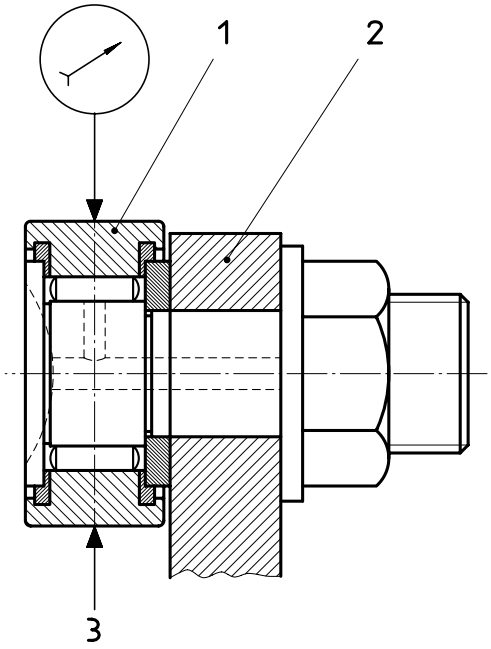
D.2.4 Record the radial internal clearance (G_r) which is the difference between maximum and minimum readings on the dial gauge.



Key

1 Bearing under test
2 Tapered mandrel
3 Alternating load for radial internal clearance test

Figure D.1



Key

1 Bearing under test
2 Rigid support
3 Alternating load for radial internal clearance test

Figure D.2

Annex E
(normative)

Verification of axial internal clearance in assembled bearing

E.1 Apparatus

See the test fixture as shown in figure E.1 for needle roller, needle track roller and cylindrical roller bearings (yoke type) or in figure E.2 for stud type track roller bearings as an example.

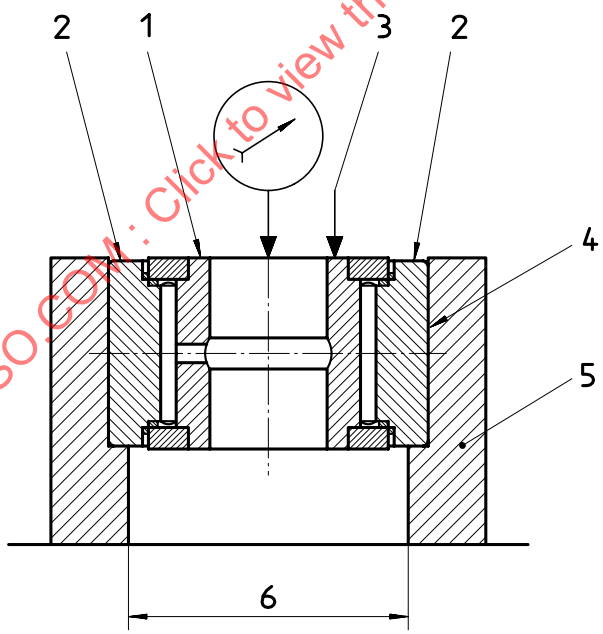
E.2 Method

E.2.1 Mount the bearing horizontally and immobilize the outer ring.

E.2.2 Position a gauge indicator on the axis of the bearing.

E.2.3 Apply a test load of 25 N alternately in one direction and then in the opposite direction.

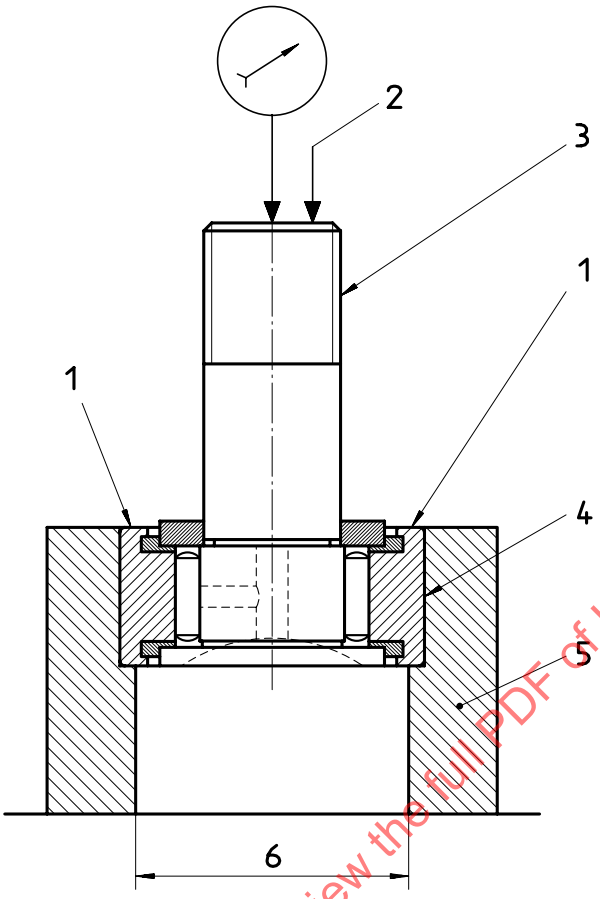
E.2.4 Record the axial internal clearance (G_a) which is the difference between the maximum and minimum readings in the gauge indicator.



Key

1 Bearing under test
2 Clamped
3 Alternating load
4 Bearing outside diameter plus 0,075 mm
5 Bearing housing
6 Bearing outside diameter minus $3 \times r_{smin}$

Figure E.1



Key

1 Clamped
2 Alternating load
3 Bearing under test
4 Bearing outside diameter plus 0,075 mm
5 Bearing housing
6 Bearing outside diameter minus 3 × $r_{s\,min}$

Figure E.2

Annex F
(normative)

Verification of end washer retention

F.1 Apparatus

See the test fixture as shown in figure F.1 for needle roller, needle track roller and cylindrical roller bearings (yoke type) or in figure F.2 for stud type roller bearings as an example.

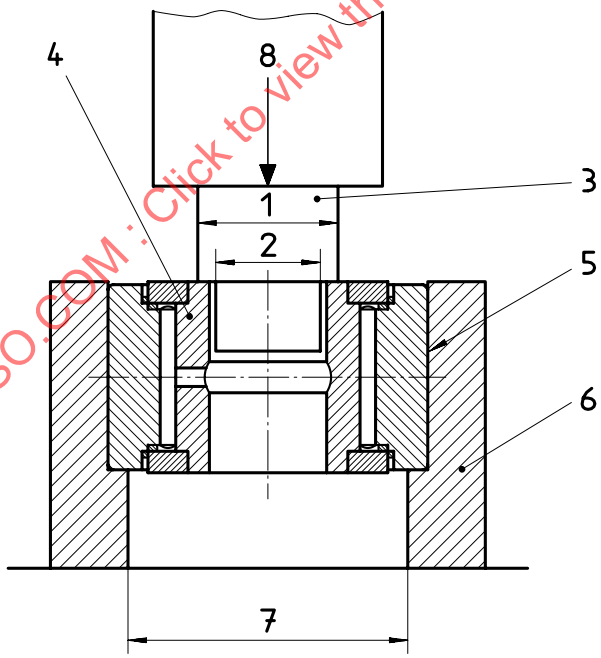
F.2 Method

F.2.1 Mount the bearing horizontally.

F.2.2 Apply an axial load of 450 N for yoke type bearings or 100 N for stud type bearings by means of a suitable mandrel for a period of 1 min.

F.2.3 For yoke type bearings, reverse the position of the bearing in the fixture and repeat.

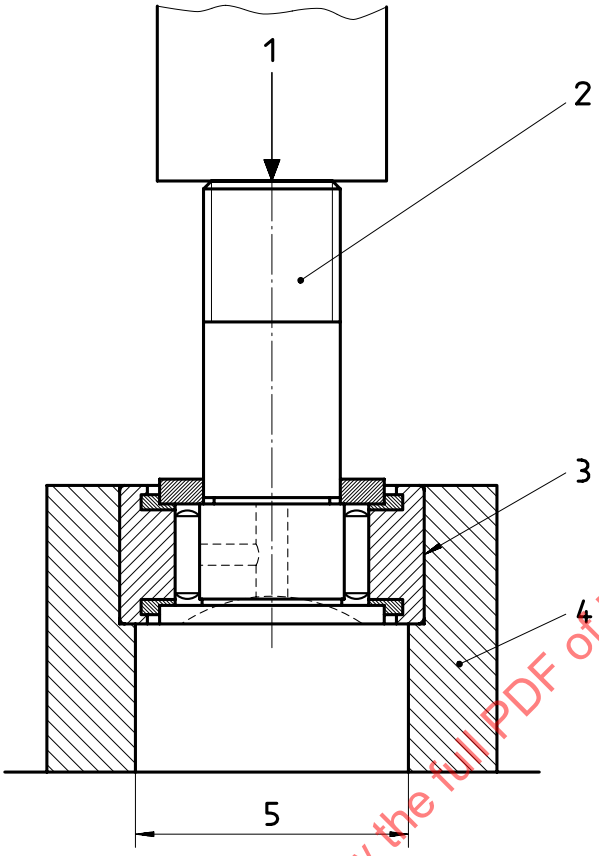
F.2.4 Inspect for end washer dislodgement and bearing rotational smoothness.



Key

1 Bore diameter plus 1,5 mm
2 Bore diameter minus 0,25 mm for diameter code 06 and below, minus 0,3 mm for diameter code 08 and above
3 Bearing plug
4 Bearing under test
5 Bearing outside diameter plus 0,075 mm
6 Bearing housing
7 Bearing outside diameter minus $3 \times r_{smin}$
8 Load

Figure F.1



Key

1 Load
2 Bearing under test
3 Bearing outside diameter plus 0,075 mm
4 Bearing housing
5 Bearing outside diameter minus $3 \times r_{smin}$

Figure F.2

Annex G
(normative)

Verification of minimum axial clearance under compression load

G.1 Apparatus

See the test fixture as shown in figure G.1 for needle roller, needle track roller and cylindrical roller bearings (yoke type) or in figure G.2 for stud type roller bearings as an example.

G.2 Method

G.2.1 Apply the axial load as defined in table G.1 below across the full bearing end face for yoke type bearings. The clamping (install) torque used for stud type bearings shall be the maximum value specified in the applicable product standard.

G.2.2 Rotate the bearing outer ring while under load to verify freedom of rotation.

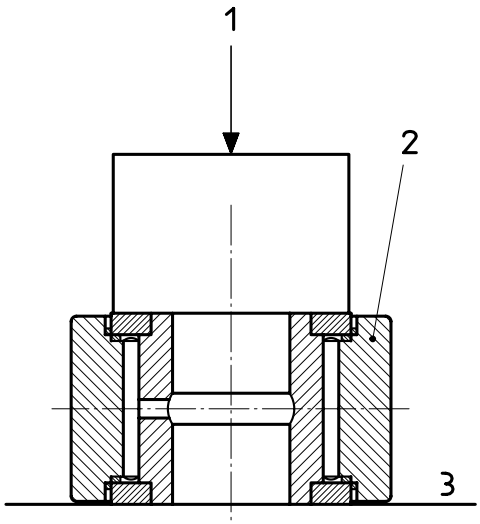
Table G.1 — Loads applied for verification of minimum axial clearance under compression load

Metric series

Bearing bore	Axial load
mm	N
6	3 200
8	6 300
10	9 900
12	14 900
14	20 200
16	27 200
20	44 300
24	62 800
30	101 700
⩾ 36	150 000

Inch series

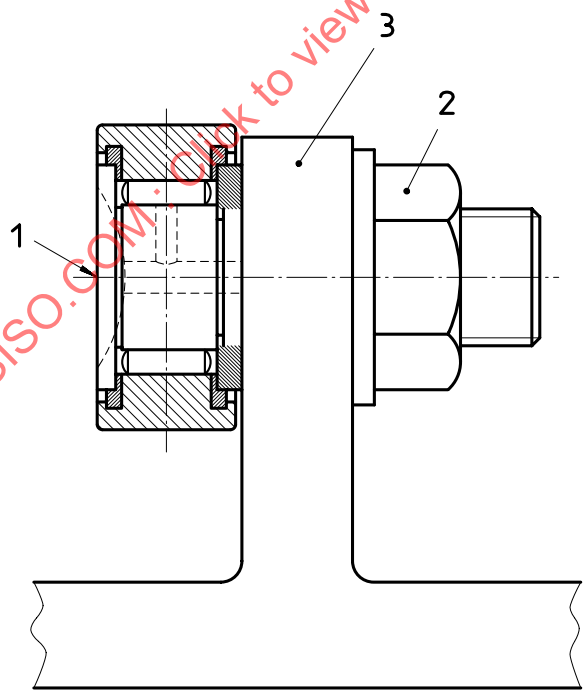
Bearing bore		Axial load	
mm	in	N	lbf
4,286	0,19	2 135	480
6,35	0,25	3 870	870
7,925	0,312 5	6 227	1 400
9,525	0,375	9 341	2 100
11,1	0,437 5	12 677	2 850
12,7	0,5	16 903	3 800
14,287 5	0,562 5	21 662	4 870
15,875	0,625	27 356	6 150
19,05	0,75	39 811	8 950
22,225	0,875	54 268	12 200
25,4	1	72 506	16 300
⩾ 31,75	⩾ 1,25	114 764	25 800



Key

1 Load
2 Bearing under test
3 Flat surface

Figure G.1



Key

1 Bearing under test
2 Nut to be tightened to the torque required by the applicable product standard
3 Rigid support

Figure G.2