
**Rolling bearings — Needle roller
bearings with drawn cup and without
inner ring — Boundary dimensions,
geometrical product specifications
(GPS) and tolerance values**

*Roulements — Douilles à aiguilles sans bague intérieure —
Dimensions d'encombrement, spécification géométrique des produits
(GPS) et valeurs de tolérance*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 4, *Rolling bearings*, Subcommittee SC 5, *Needle, cylindrical and spherical roller bearings*.

This fifth edition cancels and replaces the fourth edition (ISO 3245:2015), which has been technically revised.

The main changes are as follows:

- [Figure 1 a](#)) has been updated;
- the symbol for characteristic ΔF_{ws} has been replaced with ΔF_{wgn} ;
- [Annex B](#) on measuring and verification methods has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a machine element geometry standard as defined in the geometrical product specification system (GPS system) as presented in matrix model of ISO 14638.

The fundamental rules of ISO/GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated.

The connection between functional requirements, measuring technique and measuring uncertainty is always intended to be considered. For measurement uncertainty, it is intended that ISO 14253-2 be considered.

Recommended values for the tolerances for shaft raceway and housing bore are given in [Annex A](#).

Guidelines for measurement and verification of the specific characteristic of needle roller bearings with drawn cup and without inner ring are given in [Annex B](#).

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Rolling bearings — Needle roller bearings with drawn cup and without inner ring — Boundary dimensions, geometrical product specifications (GPS) and tolerance values

1 Scope

This document specifies the boundary dimensions and preferred dimensions to be used for drawn cup needle roller bearings without inner ring as well as the minimum chamfer dimension limits. This document also specifies the closed end thickness dimensions for bearings with one closed end.

In addition, this document specifies dimensional tolerances for the needle roller complement bore diameter and tolerances for the drawn cup width.

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.

ISO 5593, *Rolling bearings — Vocabulary*

ISO 10579, *Geometrical product specifications (GPS) — Dimensioning and tolerancing — Non-rigid parts*

ISO 14405-1, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO/TS 17863, *Geometrical product specification (GPS) — Tolerancing of moveable assemblies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5593, ISO 14405-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

constraint diameter

D_{1c}

diameter of the feature used in constraint condition to evaluate ΔF_{wgn} characteristics

Note 1 to entry: It corresponds to the diameter of the master ring gauge in [Annex B](#).

4 Symbols

For the purposes of this document, the symbols given in ISO 15241 and the following apply.

Descriptions for symbols are in accordance to GPS terminology. The dimensional specifications are described in [Table 1](#) and [Figure 1](#).

Figure 1 presents the dimensioning associated to a needle roller bearing, using the symbols introduced in Table 1.

Tolerance value associated to a characteristic is symbolized by t followed by the symbol of characteristic, for example, $t_{\Delta C_s}$.

In this document, the ISO default specification operator for size is according to ISO 14405-1; i.e. the two-point size is valid.

Table 1 — Symbols for nominal dimensions, characteristics and specification modifiers

Symbol for nominal size and distance ^a	Symbol for characteristic	Specification modifier ^b	Description
C			nominal drawn cup width
	ΔC_s	(GN)	deviation of minimum circumscribed size of drawn cup width from its nominal size
C_1			nominal end thickness of profiled end drawn cup
	C_{1s}	(GN)	single end thickness of profiled end drawn cup (minimum circumscribed distance)
C_2			nominal end thickness of flat end drawn cup
	C_{2s}	(GN)	single end thickness of flat end drawn cup (minimum circumscribed distance)
D			nominal drawn cup outside diameter
F_w			nominal bore diameter of needle roller complement
	ΔF_{wgn}^c	(GX) (SN)	deviation of the smallest ^d maximum inscribed cylinder sizes of bore diameter of needle roller complement from its nominal size
r			nominal chamfer ^e dimension
	r_s		single chamfer dimension

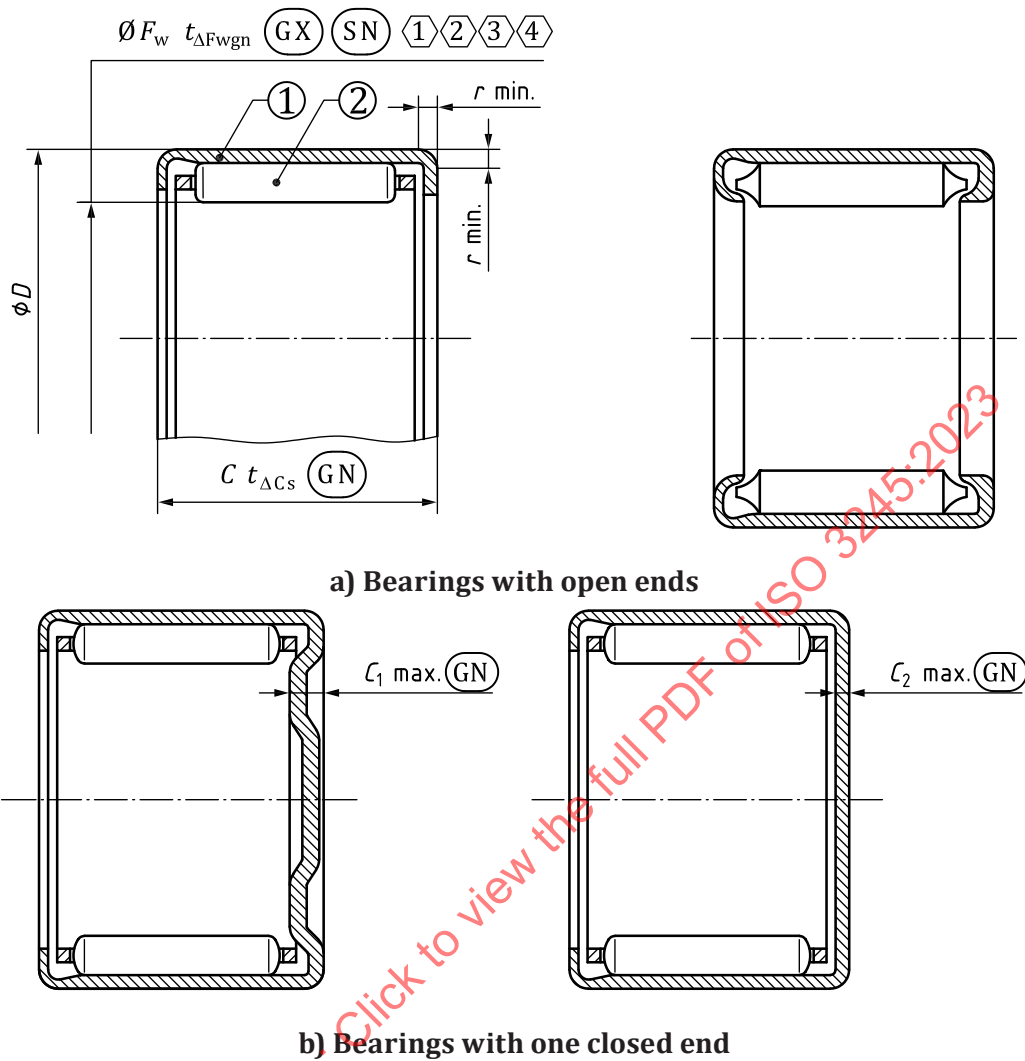
^a Symbols as defined in ISO 15241 except for the format used.

^b Symbols as defined in ISO 14405-1.

^c Constraint condition and specification modifiers for fixed parts and movable parts shall be in accordance with ISO/TS 17863; see Figure 1.

^d Considering the influence of the rotation of the needle roller complement.

^e The chamfer is considered in this document as a round corner.



- Key**
- ① valid in constraint condition by fitting ① into a ring gage having a bore diameter equal to D_{1c} according to [Table 4](#) or [Table 5](#)
 - ② FP ① – MP ②
 - ③ needle rollers shall be in contact with the raceway of the drawn cup
 - ④ in any rotation, in a coaxial direction
 - ① drawn cup
 - ② needle roller complement

Figure 1 — Example of drawn cup needle roller bearing without inner ring design

5 Nominal boundary dimensions

The nominal boundary dimensions of drawn cup needle roller bearings, without inner ring, one closed end and open ends, of diameter series 1D are given in [Table 2](#), those of diameter series 2D are given in [Table 3](#).

Table 2 — Nominal boundary dimensions of needle roller bearings without inner ring, with open ends or one closed end — Diameter series 1D

Dimensions in millimetres

F_w	D	C								C_1^a	C_2^a	r^b
		Dimension series										
		21D	31D	41D	51D	61D	71D	81D	91D			
4	8	7	8	9	—	—	—	—	—	1,9	1	0,3
5	9	7	8	9	—	—	—	—	—	1,9	1	0,4
6	10	7	8	9	10	—	—	—	—	1,9	1	0,4
7	11	7	8	9	10	12	—	—	—	1,9	1	0,4
8	12	7	8	9	10	12	—	—	—	1,9	1	0,4
9	13	7	8	9	10	12	14	—	—	1,9	1	0,4
10	14	7	8	9	10	12	14	—	—	1,9	1	0,4
12	16	7	8	9	10	12	14	—	—	1,9	1	0,4
14	20	10	12	14	16	18	20	—	—	2,8	1,3	0,4
15	21	10	12	14	16	18	20	—	—	2,8	1,3	0,4
16	22	10	12	14	16	18	20	—	—	2,8	1,3	0,4
17	23	10	12	14	16	18	20	—	—	2,8	1,3	0,4
18	24	10	12	14	16	18	20	—	—	2,8	1,3	0,4
20	26	10	12	14	16	18	20	—	—	2,8	1,3	0,4
22	28	10	12	14	16	18	20	—	—	2,8	1,3	0,4
25	32	12	14	16	18	20	24	28	32	2,8	1,3	0,8
28	35	12	14	16	18	20	24	28	32	2,8	1,3	0,8
30	37	12	14	16	18	20	24	28	32	2,8	1,3	0,8
32	39	12	14	16	18	20	24	28	32	2,8	1,3	0,8
35	42	12	14	16	18	20	24	28	32	2,8	1,3	0,8
38	45	12	14	16	18	20	24	28	32	2,8	1,3	0,8
40	47	12	14	16	18	20	24	28	32	2,8	1,3	0,8
42	49	12	14	16	18	20	24	28	32	2,8	1,3	0,8
45	52	12	14	16	18	20	24	28	32	2,8	1,3	0,8
50	58	14	16	18	20	24	28	32	36	2,8	1,6	0,8
55	63	14	16	18	20	24	28	32	36	2,8	1,6	0,8
60	68	14	16	18	20	24	28	32	36	2,8	1,6	0,8
65	73	14	16	18	20	24	28	32	36	2,8	1,6	0,8
70	78	14	16	18	20	24	28	32	36	2,8	1,6	0,8

NOTE Underlined values are the preferred dimensions.

^a The upper specification limits of C_{1s} and C_{2s} are defined respectively as C_1 and C_2 .

^b The lower specification limit for chamfer dimension, r_s , is defined as r .

Table 3 — Nominal boundary dimensions of needle roller bearings without inner ring, with open ends or one closed end — Diameter series 2D

Dimensions in millimetres

F_w	D	C							C_1^a	C_2^a	r^b
		Dimension series									
		22D	32D	42D	52D	62D	72D	82D			
8	14	10	12	14	—	—	—	—	2,8	1,3	0,4
9	15	10	12	14	16	—	—	—	2,8	1,3	0,4
10	16	10	12	14	16	—	—	—	2,8	1,3	0,4
12	18	10	12	14	16	18	—	—	2,8	1,3	0,4
14	22	12	14	16	18	20	24	—	2,8	1,3	0,4
15	23	12	14	16	18	20	24	—	2,8	1,3	0,4
16	24	12	14	16	18	20	24	—	2,8	1,3	0,8
17	25	12	14	16	18	20	24	—	2,8	1,3	0,8
18	26	12	14	16	18	20	24	—	2,8	1,3	0,8
20	28	12	14	16	18	20	24	—	2,8	1,3	0,8
22	30	12	14	16	18	20	24	—	2,8	1,3	0,8
25	35	14	16	18	20	24	28	32	3,4	1,6	0,8
28	38	14	16	18	20	24	28	32	3,4	1,6	0,8
30	40	14	16	18	20	24	28	32	3,4	1,6	0,8
32	42	14	16	18	20	24	28	32	3,4	1,6	0,8
35	45	14	16	18	20	24	28	32	3,4	1,6	0,8
38	48	14	16	18	20	24	28	32	3,4	1,6	0,8
40	50	14	16	18	20	24	28	32	3,4	1,6	0,8
42	52	14	16	18	20	24	28	32	3,4	1,6	0,8
45	55	14	16	18	20	24	28	32	3,4	1,6	0,8

^a The upper specification limits of C_{1s} and C_{2s} are defined respectively as C_1 and C_2 .

^b The lower specification limit for chamfer dimension, r_s , is defined as r .

6 Tolerances

6.1 General

In [Tables 4](#) to [6](#), the symbols U and L are used as follows:

U = upper deviation limit

L = lower deviation limit

6.2 Tolerance for the bore diameter

Drawn cup needle roller bearings that are non-rigid parts shall be in accordance with the definition given in ISO 10579. Drawn cup needle roller bearings require the outside diameter of the drawn cup to be restrained in a ring gauge for verification of the bore diameter of the needle roller complement.

The tolerances applied to dimensions C , C_1 , C_2 and r shall apply the free state condition defined in ISO 10579.

The tolerances for ΔF_{wgn} , $t_{\Delta F_{wgn}}$, are given in [Tables 4](#) and [5](#).

Table 4 — Tolerances for ΔF_{wgn} — Diameter series 1D

Dimensions in millimetres

F_w	D^a	Constraint diameter ^b D_{1c}	$t_{\Delta F_{wgn}}$	
			U	L
4	8	7,984	+0,028	+0,010
5	9	8,984		
6	10	9,984		
7	11	10,98	+0,031	+0,013
8	12	11,98		
9	13	12,98		
10	14	13,98		
12	16	15,98	+0,034	+0,016
14	20	19,976		
15	21	20,976		
16	22	21,976		
17	23	22,976		
18	24	23,976		
20	26	25,976	+0,041	+0,020
22	28	27,976		
25	32	31,972		
28	35	34,972		
30	37	36,972		
32	39	38,972	+0,050	+0,025
35	42	41,972		
38	45	44,972		
40	47	46,972		
42	49	48,972		
45	52	51,967		
50	58	57,967		
55	63	62,967	+0,060	+0,030
60	68	67,967		
65	73	72,967		
70	78	77,967		

^a No deviations are specified for the outside diameter of drawn cup, D . The bearing manufacturer shall ensure a fit corresponding to the function.

^b If the actual constraint diameter deviates from its specified value, $t_{\Delta F_{wgn}}$ should be corrected to compensate the deviation.

Table 5 — Tolerances for ΔF_{wgn} — Diameter series 2D

Dimensions in millimetres

F_w	D^a	Constraint diameter ^b D_{1c}	$t_{\Delta F_{wgn}}$	
			U	L
8	14	13,98	+0,031	+0,013
9	15	14,98		
10	16	15,98		
12	18	17,98	+0,034	+0,016
14	22	21,976		
15	23	22,976		
16	24	23,976		
17	25	24,976		
18	26	25,976		
20	28	27,976	+0,041	+0,020
22	30	29,976		
25	35	34,972		
28	38	37,972		
30	40	39,972		
32	42	41,972	+0,050	+0,025
35	45	44,972		
38	48	47,972		
40	50	49,972		
42	52	51,967		
45	55	54,967		

^a No deviations are specified for the outside diameter of drawn cup, D . The bearing manufacturer shall ensure a fit corresponding to the function.

^b If the actual constraint diameter deviates from its specified value, $t_{\Delta F_{wgn}}$ should be corrected to compensate the deviation.

6.3 Tolerance for the drawn cup

6.3.1 Drawn cup width, C

The tolerance for the drawn cup width, C , is given in [Table 6](#).

Table 6 — Tolerances for drawn cup width

Dimensions in millimetres

C	$t_{\Delta C_s}$	
	U	L
all widths	0	-0,3

6.3.2 End thickness of profiled end and flat end drawn cup C_1 and C_2

The upper specification limits of C_{1s} and C_{2s} are defined respectively as C_1 and C_2 (see [Tables 2](#) and [3](#)). These values are given to enable the user to avoid contact between the end face of the shaft and the internal end face of the drawn cup.

The lower specification limits of C_{1s} and C_{2s} are not defined.

See GPS indications in [Figure 1](#) b).

6.3.3 Chamfer dimension, r

The lower specification limit for chamfer dimension, r_s , is defined as r (see [Tables 2](#) and [3](#)).

The upper specification limit is not defined.

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Annex A (informative)

Tolerances for shaft raceway and housing bore

A.1 General

Proper function of drawn cup needle roller bearings depends on the shaft quality supplied by the user and a required press-fit into an adequate quality housing. The housing should be of sufficient strength to round and size the bearing.

This annex shows suggested tolerances and values for shaft raceway and housing bore.

Table values are informative only and may not be suitable for use in applications having certain operating conditions and features. If in doubt, consult the bearing manufacturer for specific advice.

A.2 Raceway hardness and case-hardened depth

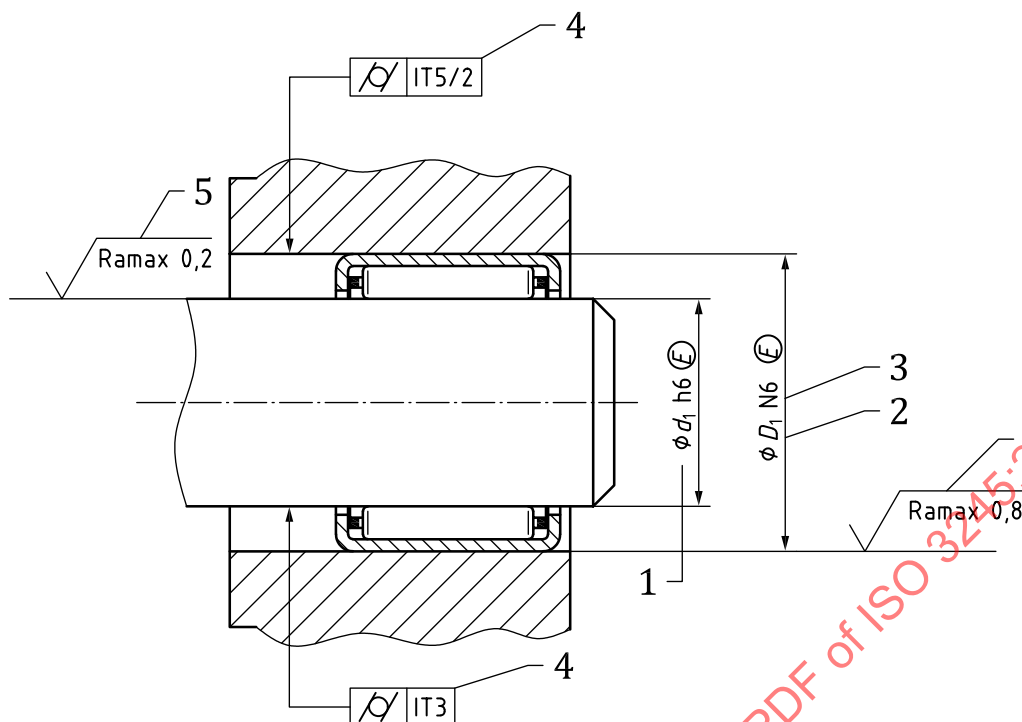
The shaft raceway is hardened and finish ground. Surface hardness is minimum 670 HV ($\approx$ 58 HRC). Case hardened depth of raceway is minimum of 0,3 mm to 0,8 mm, depending on bearing size, rolling element diameter, shaft heat treatment method and load condition. If in doubt, consult the bearing manufacturer for specific advice.

NOTE The definition of case-hardened depth is in accordance with ISO 18203:2016, 3.1.

A.3 Shaft raceway and housing bore designs

[Figure A.1](#) shows suggested shaft raceway and housing bore design values.

Tolerances are valid for stationary housing and rotating shaft. For housing rotation, consult the bearing manufacturer for specific advice. The standard tolerance grade value (IT3 and IT5) and the limit deviations defined from a tolerance class (h6 or N6), as used in [Figure A.1](#), are defined in ISO 286-1 in link with the related nominal diameter of the feature of size.



Key

- 1 nominal dimension of shaft diameter, d_1 , is equal to F_w
- 2 nominal dimension of housing bore diameter, D_1 , is equal to D
- 3 tolerance classes $N6$ for steel or cast iron housing and $R6$ for light metal housing apply
- 4 cylindricity in accordance with ISO 1101
- 5 or $\sqrt{R_{z\max} 1}$
- 6 or $\sqrt{R_{z\max} 4}$

Consult with manufacturer for specific advice on other material housing designs.

NOTE The suggested housing values apply to the mounting surface with the bearing. The shaft raceway specifications are applied to functional portion of the surface.

Figure A.1 — Shaft and housing designs

Annex B (informative)

Measuring and verification methods

B.1 General

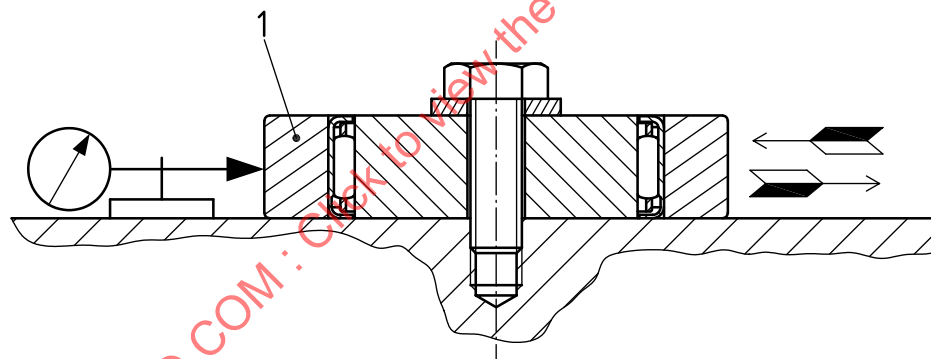
This annex gives guidelines for measurement and verification of the specific characteristic of needle roller bearings with drawn cup and without inner ring, corresponding to ΔF_{wgn} .

ΔF_{wgn} can be measured or verified by one of three methods for each type and designation of the bearing.

The measuring and verification methods described in this annex are examples and the manufacturers method can differ from those.

B.2 Examples

B.2.1 Measurement of ΔF_{wgn} with master gauge



Key

1 ring gauge

Figure B.1 — Measurement of ΔF_{wgn} with master gauge

Fasten the master gauge to a surface plate, see [Figure B.1](#).

First press the bearing into a hardened steel ring gauge of constraint diameter specified in [Tables 4](#) and [5](#). The minimum radial cross-section of the ring gauge is shown in [Table B.1](#).

Position the bearing on the master gauge and apply the indicator in the radial direction to the approximate middle of the width on the ring outside surface, see [Figure B.1](#).

Measure the radial displacement of the outer ring by applying radial load specified in [Table B.2](#) on the outer ring in the same radial direction as that of the indicator and in the opposite radial direction. Repeat this measurement in different angular positions. ΔF_{wgn} is equal to the smallest displacement plus the master gauge diameter minus F_w .