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Rolling bearings — Needle roller bearings with machined rings — Boundary dimensions, geometrical product specifications (GPS) and tolerance values

Roulements — Roulements à aiguilles avec bagues usinées — 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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 1206:2018), which has been technically revised.

The main changes are as follows:

— Figure 1 and Figure 2 have been updated;

— the symbol for characteristic ΔFws has been replaced with ΔFwgn;

— Annex C 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 (GPS) system as presented in the 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 raceways for needle roller bearings without inner ring are given in Annex A.

Guidelines for measurement and verification of the specific characteristic of needle roller bearings with machined rings are given in Annex C.

Rolling bearings — Needle roller bearings with machined rings — Boundary dimensions, geometrical product specifications (GPS) and tolerance values

1 Scope

This document specifies the boundary dimensions and normal class tolerance values for needle roller bearings with machined rings.

This document specifies dimensional and geometrical characteristics, and limit deviations from nominal sizes.

These specifications apply to complete needle roller bearings and to bearings without inner ring.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 5593, *Rolling bearings — Vocabulary*

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 1101, ISO 5593, ISO 14405-1, and ISO/TS 17863 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/

4 Symbols

Descriptions for symbols are in accordance with GPS terminology; relationships with traditional terms are described in Annex B, Table B.1. The dimensional and geometrical specifications are described in Table 1.

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

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

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

Symbol for nominal size[a]	Symbol for characteristic	GPS symbol and specification modifier[b,c]	Description[d]
B			nominal inner ring width
	VBs	(LP) (SR)	range of two-point sizes of inner ring width
	ΔBs	(LP)	deviation of a two-point size of inner ring width from its nominal size
C			nominal outer ring width
	VCs	(LP) (SR)	range of two-point sizes of outer ring width
	ΔCs	(LP)	deviation of a two-point size of outer ring width from its nominal size
d			nominal bore diameter
	Vdmp	(LP) (SD) ACS (SR)	range of mid-range sizes (out of two-point sizes) of bore diameter in any cross-section of a cylindrical bore
	Δdmp	(LP) (SD) ACS	deviation of a mid-range size (out of two-point sizes) of bore diameter in any cross-section from its nominal size
D			nominal outside diameter
	VDmp	(LP) (SD) ACS (SR)	range of mid-range sizes (out of two-point sizes) of outside diameter in any cross-section
	ΔDmp	(LP) (SD) ACS	deviation of a mid-range size (out of two-point sizes) of outside diameter in any cross-section from its nominal size
F_w			nominal bore diameter of needle roller complement
	ΔFwgn	(GX) (SN) [f]	deviation of the smallest maximum inscribed cylinder size of bore diameter of needle roller complement from its nominal size

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

[b] Symbols as defined in ISO 1101 and ISO 14405-1.

[c] Specification modifier (LP) is not indicated on a drawing if the two-point size is applied for both specified limits.

[d] Description based on ISO 1101, ISO 5459 and ISO 14405-1.

[e] Symbols for direction of gravity, G, fixed parts, FP and movable parts, MP, in accordance with ISO/TS 17863 and specific flagnotes (see Figures 1 and 2).

[f] Considering the influence of rotation of needle roller complement.

Table 1 *(continued)*

Symbol for nominal size[a]	Symbol for characteristic	GPS symbol and specification modifier[b,c]	Description[d]
	Kea	(LP) (SR) SCS ⊥ A [e]	range of two-point sizes of section height between inner ring bore surface and outer ring outside surface of assembled needle roller set and fixed inner ring in a specific cross section perpendicular to datum, i.e. axis, established from the inner ring bore surface
	Kia	(LP) (SR) SCS ⊥ B [e]	range of two-point sizes of section height between outer ring outside surface and inner ring bore surface of assembled needle roller bearing, obtained from a specific cross section of turning inner ring and needle roller set and fixed outer ring perpendicular to datum, i.e. axis, established from the outer ring outside surface
r			nominal chamfer dimension
	r_s		single chamfer dimension

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

[b] Symbols as defined in ISO 1101 and ISO 14405-1.

[c] Specification modifier (LP) is not indicated on a drawing if the two-point size is applied for both specified limits.

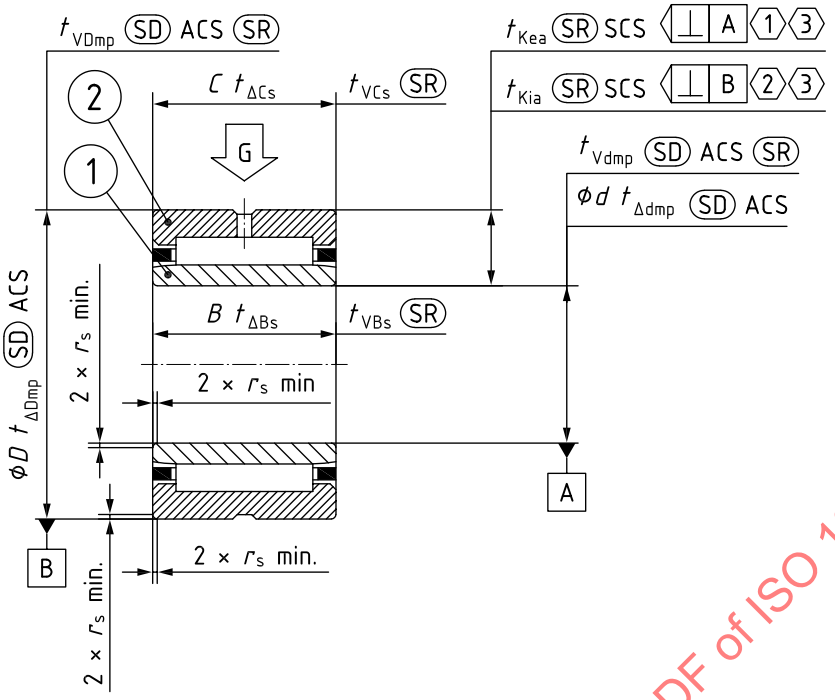
[d] Description based on ISO 1101, ISO 5459 and ISO 14405-1.

[e] Symbols for direction of gravity, G, fixed parts, FP and movable parts, MP, in accordance with ISO/TS 17863 and specific flagnotes (see Figures 1 and 2).

[f] Considering the influence of rotation of needle roller complement.

Figures 1 and 2 show GPS specifications for needle roller bearings with and without inner ring, respectively.

These principles shall be applied for all types of needle roller bearings (e.g. with or without cage, with one row or two rows of needle rollers and with or without lubrication groove and lubrication holes in the outer ring).



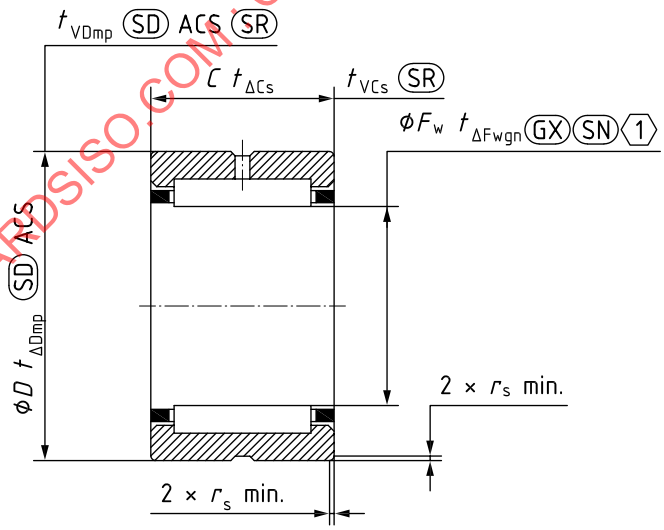
Key

1 FP ① – MP ②, G

2 FP ② – MP ①, G

3 the rolling elements shall be in correct functional contact with both the inner and outer ring raceways

Figure 1 — GPS specifications for needle roller bearing with inner ring



Key

1 influence of the rotation of the needle roller complement

Figure 2 — GPS specifications for needle roller bearing without inner ring

5 Nominal boundary and chamfer dimensions

The dimension series described in Tables 2 to 5 are defined in ISO 15. Maximum chamfer dimensions are in accordance with ISO 582.

Special series dimension are given in Table 6 for needle roller bearings with inner ring and in Table 7 for needle roller bearings without inner ring.

Table 2 — Dimension series 48

Dimensions in millimetres

Complete bearings and bearings without inner ring				
d	F_w	D	B **and** C	r_s min.
110	120	140	30	1
120	130	150	30	1
130	145	165	35	1,1
140	155	175	35	1,1
150	165	190	40	1,1
160	175	200	40	1,1
170	185	215	45	1,1
180	195	225	45	1,1
190	210	240	50	1,5
200	220	250	50	1,5
220	240	270	50	1,5
240	265	300	60	2
260	285	320	60	2
280	305	350	69	2
300	330	380	80	2,1
320	350	400	80	2,1
340	370	420	80	2,1
360	390	440	80	2,1
380	415	480	100	2,1

Table 3 — Dimension series 49

Dimensions in millimetres

Complete bearings and bearings without inner ring				
d	F_w	D	B **and** C	r_s min.
5	7	13	10	0,15
6	8	15	10	0,15
7	9	17	10	0,15
8	10	19	11	0,2
9	12	20	11	0,3
10	14	22	13	0,3
12	16	24	13	0,3
15	20	28	13	0,3
17	22	30	13	0,3

Table 3 *(continued)*

Complete bearings and bearings without inner ring				
d	F_w	D	B **and** C	r_s min.
20	25	37	17	0,3
22	28	39	17	0,3
25	30	42	17	0,3
28	32	45	17	0,3
30	35	47	17	0,3
32	40	52	20	0,6
35	42	55	20	0,6
40	48	62	22	0,6
45	52	68	22	0,6
50	58	72	22	0,6
55	63	80	25	1
60	68	85	25	1
65	72	90	25	1
70	80	100	30	1
75	85	105	30	1
80	90	110	30	1
85	100	120	35	1,1
90	105	125	35	1,1
95	110	130	35	1,1
100	115	140	40	1,1
110	125	150	40	1,1
120	135	165	45	1,1
130	150	180	50	1,5
140	160	190	50	1,5
150	170	210	60	2
160	180	220	60	2
170	190	230	60	2
180	205	250	69	2
190	215	260	69	2
200	225	280	80	2,1
220	245	300	80	2,1
240	265	320	80	2,1
260	290	360	100	2,1
280	310	380	100	2,1
300	340	420	118	3
320	360	440	118	3
340	380	460	118	3
360	400	480	118	3
380	430	520	140	4
400	450	540	140	4
420	470	560	140	4
440	490	600	160	4

Table 4 — Dimension series 59

Dimensions in millimetres

Complete bearings and bearings without inner ring				
d	F_w	D	B **and** C	r_s min.
12	16	24	16	0,3
15	20	28	18	0,3
17	22	30	18	0,3
20	25	37	23	0,3
22	28	39	23	0,3
25	30	42	23	0,3
28	32	45	23	0,3
30	35	47	23	0,3
32	40	52	27	0,6
35	42	55	27	0,6
40	48	62	30	0,6
45	52	68	30	0,6
50	58	72	30	0,6
55	63	80	34	1
60	68	85	34	1
65	72	90	34	1
70	80	100	40	1
75	85	105	40	1
80	90	110	40	1
85	100	120	46	1,1
90	105	125	46	1,1
95	110	130	46	1,1
100	115	140	54	1,1
105	120	145	54	1,1
110	125	150	54	1,1
120	135	165	60	1,1
130	150	180	67	1,5
140	160	190	67	1,5

Table 5 — Dimension series 69

Dimensions in millimetres

Complete bearings and bearings without inner ring				
d	F_w	D	B **and** C	r_s min.
10	14	22	22	0,3
12	16	24	22	0,3
15	20	28	23	0,3
17	22	30	23	0,3
20	25	37	30	0,3
22	28	39	30	0,3

Table 5 *(continued)*

Complete bearings and bearings without inner ring				
d	F_w	D	B **and** C	r_s min.
25	30	42	30	0,3
28	32	45	30	0,3
30	35	47	30	0,3
32	40	52	36	0,6
35	42	55	36	0,6
40	48	62	40	0,6
45	52	68	40	0,6
50	58	72	40	0,6
55	63	80	45	1
60	68	85	45	1
65	72	90	45	1
70	80	100	54	1
75	85	105	54	1
80	90	110	54	1
85	100	120	63	1,1
90	105	125	63	1,1
95	110	130	63	1,1
100	115	140	71	1,1

Table 6 — Special series dimensions for needle roller bearings with inner ring

Dimensions in millimetres

d	F_w	D	B **and** C	r_s min.[a]
5	8	15	12	0,15
5	8	15	16	0,15
6	9	16	12	0,15
6	9	16	16	0,15
7	10	17	12	0,15
7	10	17	16	0,15
9	12	19	12	0,3
9	12	19	16	0,3
9	15	26	16	0,3
10	14	22	16	0,3
10	14	22	20	0,3
12	16	24	20	0,3
15	19	27	16	0,3
15	19	27	20	0,3
15	22	35	20	0,6
17	21	29	16	0,3
17	21	29	20	0,3

[a] Chamfer dimensions r_s min. are selected minimum values which are used in major manufacturers. It is recommended to contact manufacturers for actual chamfer dimensions.

Table 6 *(continued)*

d	F_w	D	B **and** C	r_s min.[a]
17	24	37	20	0,6
20	24	32	16	0,3
20	24	32	20	0,3
20	28	42	20	0,6
22	26	34	16	0,3
22	26	34	20	0,3
25	29	38	20	0,3
25	29	38	30	0,3
25	32	47	22	0,3
28	32	42	20	0,3
28	32	42	30	0,3
30	35	45	20	0,3
30	35	45	30	0,3
30	37	52	22	0,6
32	37	47	20	0,3
32	37	47	30	0,3
35	40	50	20	0,3
35	40	50	30	0,3
35	43	58	22	0,6
38	43	53	20	0,3
38	43	53	30	0,3
40	45	55	20	0,3
40	45	55	30	0,3
40	50	65	22	1
42	47	57	20	0,3
42	47	57	30	0,3
45	50	62	25	0,3
45	50	62	35	0,3
45	55	72	22	0,6
50	55	68	25	0,3
50	55	68	35	0,3
50	60	80	28	1,1
55	60	72	25	0,3
55	60	72	35	0,3
55	65	85	28	1,1
60	68	82	25	0,6
60	68	82	35	0,6
60	70	90	28	1,1
65	73	90	25	0,6
65	73	90	35	0,6
65	75	95	28	1,1

[a] Chamfer dimensions r_s min. are selected minimum values which are used in major manufacturers. It is recommended to contact manufacturers for actual chamfer dimensions.

Table 6 *(continued)*

d	F_w	D	B **and** C	r_s min.[a]
70	80	95	25	1
70	80	95	35	1
75	85	105	25	1
75	85	105	35	1
80	90	110	25	1
80	90	110	35	1
80	95	115	32	1
85	95	115	26	1
85	95	115	36	1
90	100	120	26	1
90	100	120	36	1
95	105	125	26	1
95	105	125	36	1
100	110	130	30	1
100	110	130	40	1
100	115	135	32	1,1

[a] Chamfer dimensions r_s min. are selected minimum values which are used in major manufacturers. It is recommended to contact manufacturers for actual chamfer dimensions.

Table 7 — Special series dimensions for needle roller bearings without inner ring

Dimensions in millimetres

F_w	D	C	r_s min.[a]
5	10	10	0,15
5	10	12	0,15
6	12	10	0,15
6	12	12	0,15
7	14	10	0,15
7	14	12	0,15
15	23	16	0,3
15	23	20	0,3
17	25	16	0,3
17	25	20	0,3
18	26	13	0,3
18	26	16	0,3
18	26	20	0,3
20	28	16	0,3
20	28	20	0,3
20	32	20	0,3
22	30	16	0,3
22	30	20	0,3

[a] Chamfer dimensions r_s min. are selected minimum values which are used in major manufacturers. It is recommended to contact manufacturers for actual chamfer dimensions.

Table 7 *(continued)*

F_w	D	C	r_s min.[a]
25	33	16	0,3
25	33	20	0,3
25	38	20	0,3
28	37	20	0,3
28	37	30	0,3
30	40	20	0,3
30	40	30	0,3
30	45	22	0,6
35	50	22	0,6
38	48	20	0,3
38	48	30	0,3
40	55	22	0,6
42	52	20	0,3
42	52	30	0,3
45	58	20	0,6
45	60	22	0,6
55	70	22	0,6
60	75	22	0,6
65	78	35	0,6
65	82	25	0,6
70	85	25	0,6
70	85	35	0,6
70	88	25	0,6
75	92	25	0,6
75	92	35	0,6
75	95	30	1
95	115	30	1

[a] Chamfer dimensions r_s min. are selected minimum values which are used in major manufacturers. It is recommended to contact manufacturers for actual chamfer dimensions.

6 Tolerances

6.1 General

In Tables 8 to 10, the symbols U and L are used as follows.

U = upper deviation limit

L = lower deviation limit

6.2 Tolerances for complete bearing and bearing without inner ring

See Tables 8 to 10.

Table 8 — Inner ring: tolerance class normal

Deviation limits and tolerance values in micrometres

d mm		$t_{\Delta dmp}$		t_{Vdmp}	t_{Kia}	$t_{\Delta Bs}$		t_{VBs}
>	≤	U	L			U	L	
2,5	10	0	−8	6	10	0	−120	15
10	18	0	−8	6	10	0	−120	20
18	30	0	−10	8	13	0	−120	20
30	50	0	−12	9	15	0	−120	20
50	80	0	−15	11	20	0	−150	25
80	120	0	−20	15	25	0	−200	25
120	180	0	−25	19	30	0	−250	30
180	250	0	−30	23	40	0	−300	30
250	315	0	−35	26	50	0	−350	35
315	400	0	−40	30	60	0	−400	40
400	500	0	−45	34	65	0	−450	50

Table 9 — Outer ring: tolerance class normal

Deviation limits and tolerance values in micrometres

D mm		$t_{\Delta Dmp}$		t_{VDmp}	t_{Kea}	$t_{\Delta Cs}$	t_{VCs}
>	≤	U	L			U	L
6	18	0	−8	6	15	Identical to $t_{\Delta Bs}$ and t_{VBs} of inner ring of same bearing[a]	
18	30	0	−9	7	15		
30	50	0	−11	8	20		
50	80	0	−13	10	25		
80	120	0	−15	11	35		
120	150	0	−18	14	40		
150	180	0	−25	19	45		
180	250	0	−30	23	50		
250	315	0	−35	26	60		
315	400	0	−40	30	70		
400	500	0	−45	34	80		
500	630	0	−50	38	100		

[a] For bearings without inner ring, the values for the corresponding bearing with inner ring apply.

Table 10 — Bore diameter of needle roller complement of bearings without inner ring

Deviation limits and tolerance values in micrometres

F_w mm		$t_{\Delta Fwgn}$	
>	≤	U	L
3	6	+18	+10
6	10	+22	+13
10	18	+27	+16
18	30	+33	+20

Table 10 *(continued)*

F_w mm		$t_{\Delta Fwgn}$	
>	≤	U	L
30	50	+41	+25
50	80	+49	+30
80	120	+58	+36
120	180	+68	+43
180	250	+79	+50
250	315	+88	+56
315	400	+98	+62
400	500	+108	+68

7 Radial internal clearance

Radial internal clearance of complete bearings is the arithmetical mean of the radial distances through which one of the rings may be displaced relative to the other, from one eccentric extreme position to the diametrically opposite extreme position, in different angular directions and without being subjected to any external load.

Values for radial internal clearance of complete bearings are given in ISO 5753-1.

Annex A
(informative)

Tolerances for shaft raceways for needle roller bearings without inner ring

A.1 General

Proper function of needle roller bearings without inner rings depends on the shaft raceway supplied by the user. This annex shows suggested tolerances for shaft raceway.

Table values are informative only. In all cases, users should check the installed bearing clearance.

A.2 Raceway hardness and case-hardening depth

The shaft raceway is hardened and finish ground; surface hardness is a minimum of 670 HV (≈ 58 HRC).

In the case of using case hardening bearing steel, case-hardening 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-hardening depth is in accordance with ISO 18203:2016, 3.1.

A.3 Tolerances for shaft raceways

Table A.1 shows suggested tolerances for shaft raceways for needle roller bearings without inner ring.

Table A.1 — Tolerances for shaft raceways for needle roller bearings without inner ring

Shaft raceway tolerances for bearing without inner ring[a]					
Shaft raceway diameter[b] mm		**Deviation of shaft raceway diameter**[c]	**Surface roughness parameter** *Ra*max[f] µm	**Roundness**[d]	**Range of variation of mean diameter**[e]
>	≤	Tolerance class			
6	80	h5Ⓔ	0,2	IT3	IT3
80	200	g5Ⓔ			

[a] The limit deviation relating to the tolerance class and the value of the standard grades are given in ISO 286-1 and ISO 286-2.

[b] Shaft raceway diameter is equal to F_w.

[c] Tolerance classes apply with housing tolerances of H7 to K7; for tighter housing tolerance classes, check bearing clearance.

[d] Roundness is in accordance with ISO 1101.

[e] If cylindricity is used instead of variation of mean diameter, tolerance values for cylindricity can be different from the values of variation of mean diameter. If in doubt, consult the bearing manufacturer for specific advice. Cylindricity should be in accordance with ISO 1101.

[f] Or *Rz*max 1.

Table A.1 *(continued)*

Shaft raceway tolerances for bearing without inner ring[a]					
Shaft raceway diameter[b] mm		**Deviation of shaft raceway diameter**[c]	**Surface roughness parameter** *Ra*max[f] µm	**Roundness**[d]	**Range of variation of mean diameter**[e]
200	500	f6Ⓔ			

[a] The limit deviation relating to the tolerance class and the value of the standard grades are given in ISO 286-1 and ISO 286-2.

[b] Shaft raceway diameter is equal to F_w.

[c] Tolerance classes apply with housing tolerances of H7 to K7; for tighter housing tolerance classes, check bearing clearance.

[d] Roundness is in accordance with ISO 1101.

[e] If cylindricity is used instead of variation of mean diameter, tolerance values for cylindricity can be different from the values of variation of mean diameter. If in doubt, consult the bearing manufacturer for specific advice. Cylindricity should be in accordance with ISO 1101.

[f] Or *Rz*max 1.

Annex B
(informative)

Symbols and terms as given in ISO 1206:2001 in relation to descriptions given in this document

Table B.1 — Description of symbols

Symbol for nominal dimension	Symbol for characteristic	Term as given in ISO 1206:2001	Description given in this document
B		inner ring width	nominal inner ring width
	VBs	variation of inner ring width	range of two-point sizes of inner ring width
	ΔBs	deviation of a single inner ring width	deviation of a two-point size of inner ring width from its nominal size
C		outer ring width	nominal outer ring width
	VCs	variation of outer ring width	range of two-point sizes of outer ring width
	ΔCs	deviation of a single outer ring width	deviation of a two-point size of outer ring width from its nominal size
d		bore diameter	nominal bore diameter
	Vdmp	variation of mean bore diameter	range of mid-range sizes (out of two-point sizes) of bore diameter in any cross-section of a cylindrical bore
	Δdmp	deviation of mean bore diameter in a single plane	deviation of a mid-range size (out of two-point sizes) of bore diameter in any cross-section from its nominal size
D		outside diameter	nominal outside diameter
	VDmp	variation of mean outside diameter	range of mid-range sizes (out of two-point sizes) of outside diameter in any cross-section
	ΔDmp	deviation of mean outside diameter in a single plane	deviation of a mid-range size (out of two-point sizes) of outside diameter in any cross-section from its nominal size
F_w		bore diameter of needle roller complement	nominal bore diameter of needle roller complement
	ΔFwgn		deviation of maximum inscribed cylinder sizes of bore diameter of needle roller complement from its nominal size
	Kea	radial run-out of outer ring of assembled bearing	range of two-point sizes of section height between inner ring bore surface and outer ring outside surface of assembled needle roller set and fixed inner ring in a specific cross section perpendicular to datum, i.e. axis, established from the inner ring bore surface
	Kia	radial run-out of inner ring of assembled bearing	range of two-point sizes of section height between outer ring outside surface and inner ring bore surface of assembled needle roller bearing, obtained from a specific cross section of turning inner ring and needle roller set and fixed outer ring perpendicular to datum, i.e. axis, established from the outer ring outside surface
r		chamfer dimension	nominal chamfer dimension