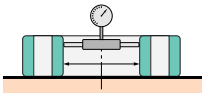
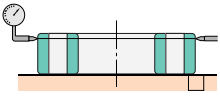
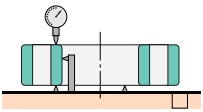
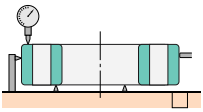
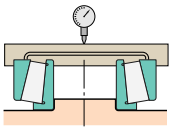
BEARING MANUFACTURING PRECISION STANDARDS

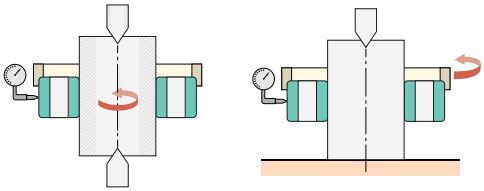
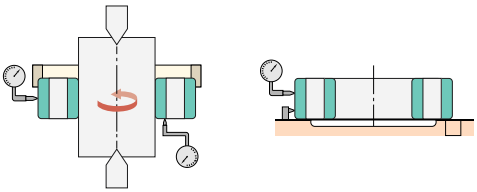
	ISO tolerance class	AFNOR tolerance class	ABEC tolerance class	DIN tolerance class
Standard precision	Normal	Normal	1	P0
High Precision	6 5 4 2	6 5 4 2	3 5 7 9	P6 P5 P4 P2

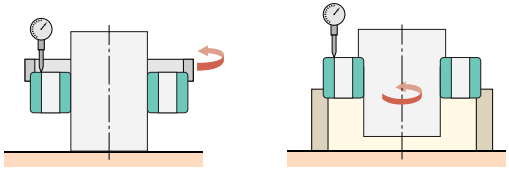
CODEX can offer reduced tolerances on certain dimensions or characteristics to avoid expensive high-precision bearings.

CHARACTERISTICS DESIGNATION AND EXPLANATION

Dimensional tolerances	Deviations	
d: nominal bore diameter 	Δdmp	Deviation of a mean bore diameter in an isolated plane (tolerance on the mean diameter)
	Vdp	Variation in the bore diameter in an isolated radial plane (ovality)
	Vdmp	Variation in the mean bore diameter (applies only to a cylindrical bore) in different planes
D: nominal outside diameter 	ΔDmp	Deviation of a mean outside diameter in an isolated plane (tolerance on the mean diameter)
	Vdp	Variation in the outside diameter in an isolated radial plane (ovality)
	VDmp	Variation in the mean outside diameter in different planes
B: nominal width of ring 	ΔBs	Deviation of an isolated width of the inner ring (width tolerance)
	VBs	Variation in the width of the inner ring (face parallelism)

Dimensional tolerances	Deviations	
C: nominal width of ring 	ΔCs	Deviation of an isolated width of the outer ring (width tolerance)
	VCs	Variation in the width of the outer ring (face parallelism)
T: nominal width of tapered bearing T1: effective nominal width of the internal sub-assembly T2: effective nominal width of the external sub-assembly 	ΔTs	Deviation in the actual width of the bearing
	ΔT1s	Deviation in the effective actual width of the internal sub-assembly
	ΔT2s	Deviation in the effective actual width of the external sub-assembly

Functional tolerances	Deviations	
radial run-out 	Kia	Radial run-out of the inner ring on the assembled bearing
	Kea	Radial run-out of the outer ring on the assembled bearing
run-out of the reference face 	Sd	Axial run-out of the reference face (or large face it applicable) of the inner ring with respect to the bore (run-out of the face of the inner ring)
	SD	Perpendicularity error of the external surface with respect to the reference face (or large face) of the outer ring (external surface run-out)

Functional tolerances	Deviations	
bearing raceaway run-out 	Sea	Axial run-out of the reference face (or large face) of the outer ring with respect to the bearing raceway, on the assembled bearing (run-out of outer ring raceway)
	Sia	Axial run-out of the inner ring with respect to the bearing raceway on the assembled bearing (run-out of the inner ring raceway)

Radial bearings – Normal tolerance classes

With the exception of tapered roller bearings and thrust bearings. Standard ISO 492.

INNER RING

Units: µm

d (mm)	Δdmp		Vdp(1) Series			Vdmp	Kia	ΔBs			VBs
			9	0,1	2,3,4			all	normal	modified(1)	
	upper	lower	max			max	max	upper	lower		max
0,6≤d≤2,5	0	-8	10	8	6	6	10	0	-40	-	12
2,5<d≤10	0	-8	10	8	6	6	10	0	-120	-250	15
10<d≤18	0	-8	10	8	6	6	10	0	-120	-250	20
18<d≤30	0	-10	13	10	8	8	13	0	-120	-250	20
30<d≤50	0	-12	15	12	9	9	15	0	-120	-250	20
50<d≤80	0	-15	19	19	11	11	20	0	-150	-380	25
80<d≤120	0	-20	25	25	15	15	25	0	-200	-380	25
120<d≤180	0	-25	31	31	19	19	30	0	-250	-500	30
180<d≤250	0	-30	38	38	23	23	40	0	-300	-500	30
250<d≤315	0	-35	44	44	26	26	50	0	-350	-500	35
315<d≤400	0	-40	50	50	30	30	60	0	-400	-630	40
400<d≤500	0	-45	56	56	34	34	65	0	-450	-	50
500<d≤630	0	-50	63	63	38	38	70	0	-500	-	60
630<d≤800	0	-75	-	-	-	-	80	0	-750	-	70
800<d≤1000	0	-100	-	-	-	-	90	0	-1000	-	80

(1) relates to the rings of isolated bearings for installation in pairs or per unit

OUTER RING

Units: µm

D (mm)	ΔDmp		VDp(1)				VDmp(1)	Kea	ΔCs ΔC1s(2)		VCs VC1s(2)
			Open bearings			Shielded bearings					
			Series								
			9	0,1	2,3,4	2,3,4					
	upper	lower	max				max	max	upper	lower	max
2,5≤D≤6	0	-8	10	8	6	10	6	15	Identical to ΔBs and VBs of the inner ring of the same bearing		
6<D≤18	0	-8	10	8	6	10	6	15			
18<D≤30	0	-9	12	9	7	12	7	15			
30<D≤50	0	-11	14	11	8	16	8	20			
50<D≤80	0	-13	16	13	10	20	10	25			
80<D≤120	0	-15	19	19	11	26	11	35			
120<D≤150	0	-18	23	23	14	30	14	40			
150<D≤180	0	-25	31	31	19	38	19	45			
180<D≤250	0	-30	38	38	23	-	23	50			
250<D≤315	0	-35	44	44	26	-	26	60			
315<D≤400	0	-40	50	50	30	-	30	70			
400<D≤500	0	-45	56	56	34	-	34	80			
500<D≤630	0	-50	63	63	38	-	38	100			
630<D≤800	0	-75	94	94	55	-	55	120			
800<D≤1000	0	-100	125	125	75	-	75	140			

Note: the tolerances on the outside diameter D1 of the flange on the outer ring are given in standard ISO 492.

(1) taken before fitting and after removal of the inner or outer snap ring

(2) only applies to ball and grooved bearings

High precision radial bearings – Tolerance class 6

With the exception of tapered roller bearings and thrust bearings. Standard ISO 492.

INNER RING

Units: µm

d (mm)	Δdmp		Vdp Series			Vdmp	Kia	ΔBs			VBs
			9	0,1	2,3,4			all	normal	modified(1)	
	upper	lower	max			max	max	upper	lower		max
0,6≤d≤2,5	0	-7	9	7	5	5	5	0	-40	-	12
2,5<d≤10	0	-7	9	7	5	5	6	0	-120	-250	15
10<d≤18	0	-7	9	7	5	5	7	0	-120	-250	20
18<d≤30	0	-8	10	8	6	6	8	0	-120	-250	20
30<d≤50	0	-10	13	10	8	8	10	0	-120	-250	20
50<d≤80	0	-12	15	15	9	9	10	0	-150	-380	25
80<d≤120	0	-15	19	19	11	11	13	0	-200	-380	25
120<d≤180	0	-18	23	23	14	14	18	0	-250	-500	30
180<d≤250	0	-22	28	28	17	17	20	0	-300	-500	30
250<d≤315	0	-25	31	31	19	19	25	0	-350	-500	35
315<d≤400	0	-30	38	38	23	23	30	0	-400	-630	40
400<d≤500	0	-35	44	44	26	26	35	0	-450	-	45
500<d≤630	0	- 40	50	50	30	30	40	0	-500	-	50

(1) Relates to the rings of isolated bearings for installation in pairs or per unit

OUTER RING

Units: µm

D (mm)	ΔDmp		VDp(1) Open bearings Series			Shielded bearings	VDmp(1)	Kea	ΔCs ΔC1s(2)		VCs VC1s (2)
			9	0,1	2,3,4	0,1,2,3,4					
	upper	lower	max				max	max	upper	lower	max
2,5≤D≤6	0	-7	9	7	5	9	5	8	Identical to ΔBs and VBs of the inner ring of the same bearing		
6<D≤18	0	-7	9	7	5	9	5	8			
18<D≤30	0	-8	10	8	6	10	6	9			
30<D≤50	0	-9	11	9	7	13	7	10			
50<D≤80	0	-11	14	11	8	16	8	13			
80<D≤120	0	-13	16	16	10	20	10	18			
120<D≤150	0	-15	19	19	11	25	11	20			
150<D≤180	0	-18	23	23	14	30	14	23			
180<D≤250	0	-20	25	25	15	-	15	25			
250<D≤315	0	-25	31	31	19	-	19	30			
315<D≤400	0	-28	35	35	21	-	21	35			
400<D≤500	0	-33	41	41	25	-	25	40			
500<D≤630	0	-38	48	48	29	-	29	50			
630<D≤800	0	-45	56	56	34	-	34	60			
800<D≤1000	0	-60	75	75	45	-	45	75			

Note: the tolerances on the outside diameter D1 of the flange on the outer ring are given in standard ISO 492.
(1) taken before fitting and after removal of the inner or outer snap ring
(2) only applies to ball and grooved bearings

High precision radial bearings – Tolerance class 5

With the exception of tapered roller bearings and thrust bearings. Standard ISO 492.

INNER RING

Units: µm

d (mm)	ΔdmpΔ		Vdp Series		Vdmp	Kia	Sd	Sia[1]	ΔBs			VBs
			9	0,1, 2,3,4					all	normal	modified[2]	
	upper	lower	max		max	max	max		upper	lower		max
0,6≤d≤2,5	0	-5	5	4	3	4	7	7	0	-40	- 250	5
2,5<d≤10	0	-5	5	4	3	4	7	7	0	-40	-250	5
10<d≤18	0	-5	5	4	3	4	7	7	0	-80	-250	5
18<d≤30	0	-6	6	5	3	4	8	8	0	-120	-250	5
30<d≤50	0	-8	8	6	4	5	8	8	0	-120	-250	5
50<d≤80	0	-9	9	7	5	5	8	8	0	-150	-250	6
80<d≤120	0	-10	10	8	5	6	9	9	0	-200	-380	7
120<d≤180	0	-13	13	10	7	8	10	10	0	-250	-380	8
180<d≤250	0	-15	15	12	8	10	11	13	0	-300	-500	10
250<d≤315	0	-18	18	14	9	13	13	15	0	-350	-500	13
315<d≤400	0	-23	23	18	12	15	15	20	0	-400	-630	15

(1) Only applies to ball and grooved bearings.
(2) Relates to the rings of isolated bearings for installation in pairs or per unit.

OUTER RING

Units: µm

D (mm)	ΔDmp		VDp Series		VDmp	Kea	SD[1] SD1[2]	Sea[1,2]	Sea1[2]	ΔCs ΔC1s[2]		VCs VC1s[2]
			9	0,1, 2,3,4								
	upper	lower	max		max	max	max	max	max	upper	lower	max
2,5≤D≤6	0	-5	5	4	3	5	8	8	11	Identical to ΔBs and VBs of the inner ring of the same bearing		5
6<D≤18	0	-5	5	4	3	5	8	8	11			5
18<D≤30	0	-5	6	5	3	6	8	8	11			5
30<D≤50	0	-7	7	5	4	7	8	8	11			5
50<D≤80	0	-9	9	7	5	8	8	10	14			6
80<D≤120	0	-10	10	8	5	10	9	11	16			8
120<D≤150	0	-11	11	8	6	11	10	13	18			8
150<D≤180	0	-13	13	10	7	13	10	14	20			8
180<D≤250	0	-15	15	11	8	15	11	15	21			10
250<D≤315	0	-18	18	14	9	18	13	18	25			11
315<D≤400	0	-20	20	15	10	20	13	20	28			13
400<D≤500	0	-23	23	17	12	23	15	23	33			15
500<D≤630	0	-28	28	21	14	25	18	25	35			18
630<D≤800	0	-35	35	26	18	30	20	30	42			20

Note: The tolerances on the outside diameter, D1, of the flange on the outer ring are given in standard ISO 492.
(1) Does not apply to bearings with a flange-type outer ring.
(2) Only applies to ball and grooved bearings.

High precision radial bearings – Tolerance class 4

With the exception of tapered roller bearings and thrust bearings. Standard ISO 492.

INNER RING

Units: µm

d (mm)	Δdmp(1)		Δds		Vdp(1) Series		Vdmp	Kia	Sd	Sia(2)	ΔBs			VBs
					9	0,1,2,3,4					all	normal	modified(2)	
	upper	lower	upper	lower	max		max	max	max	max	upper	lower		max
0.6≤d≤2.5	0	-4	0	-4	4	3	2	2.5	3	3	0	-40	-250	2.5
2.5<d≤10	0	-4	0	-4	4	3	2	2.5	3	3	0	-40	-250	2.5
10<d≤18	0	-4	0	-4	4	3	2	2.5	3	3	0	-80	-250	2.5
18<d≤30	0	-5	0	-5	5	4	2.5	3	4	4	0	-120	-250	2.5
30<d≤50	0	-6	0	-6	6	5	3	4	4	4	0	-120	-250	3
50<d≤80	0	-7	0	-7	7	5	3.5	4	5	5	0	-150	-250	4
80<d≤120	0	-8	0	-8	8	6	4	5	5	5	0	-200	-380	4
120<d≤180	0	-10	0	-10	10	8	5	6	6	7	0	-250	-380	5
180<d≤250	0	-12	0	-12	12	9	6	8	7	8	0	-300	-500	6

(1) These differences appy to diameter series 0, 1, 2, 3 and 4 only.
(2) Only applies to ball and grooved bearings
(3) Relates to the rings of isolated bearings for installation in pairs or per unit.

OUTER RING

Units: µm

D (mm)	ΔDmp		ΔDs(1)		VDp(1) Series		VDmp	Kea	Sd(2) Sd1(3)	Sea(2,3)	Sea1(3)	ΔCs ΔC1s(3)		VCs VC1s(3)
					9	0,1,2,3,4								
	upper	lower	upper	lower	max		max	max	max	max	max	upper	lower	max
2.5≤D≤6	0	-4	0	-4	4	3	2	3	4	5	7	Identical to ΔBs of the inner ring of the same bearing		2.5
6<D≤18	0	-4	0	-4	4	3	2	3	4	5	7			2.5
18<D≤30	0	-5	0	-5	5	4	2.5	4	4	5	7			2.5
30<D≤50	0	-6	0	-6	6	5	3	5	4	5	7			2.5
50<D≤80	0	-7	0	-7	7	5	3,5	5	4	5	7			3
80<D≤120	0	-8	0	-8	8	6	4	6	5	6	8			4
120<D≤150	0	-9	0	-9	9	7	5	7	5	7	10			5
150<D≤180	0	-10	0	-10	10	8	5	8	5	8	11			5
180<D≤250	0	-11	0	-11	11	8	6	10	7	10	14			7
250<D≤315	0	-13	0	-13	13	10	7	11	8	10	14			7
315<D≤400	0	-15	0	-15	15	11	8	13	10	13	18			8

Note: The tolerances on the outside diameter, D1, of the flange on the outer ring are given in standard ISO 492.
(1) These differences apply to diameter series 0, 1, 2, 3 and 4 only.
(2) Only applies to ball and grooved bearings.
(3) Relates to the rings of isolated bearings for installation in pairs or per unit.

High precision radial bearings – Tolerance class 2

With the exception of tapered roller bearings and thrust bearings. Standard ISO 492.

INNER RING

Units: µm

d (mm)	Δdmp		Δds		Vdp(1)	Vdmp	Kia	Sd	Sia(2)	ΔBs			VBs
										all	normal	modified(3)	
	upper	lower	upper	lower	max	max	max	max	max	upper	lower		max
0.6≤d≤2.5	0	-2.5	0	-2.5	2.5	1.5	1.5	1.5	1.5	0	-40	-250	1.5
2.5<d≤10	0	-2.5	0	-2.5	2.5	1.5	1.5	1.5	1.5	0	-40	-250	1.5
10<d≤18	0	-2.5	0	-2.5	2.5	1.5	1.5	1.5	1.5	0	-80	-250	1.5
18<d≤30	0	-2.5	0	-2.5	2.5	1.5	2.5	1.5	2.5	0	-120	-250	1.5
30<d≤50	0	-2.5	0	-2.5	2.5	1.5	2.5	1.5	2.5	0	-120	-250	1.5
50<d≤80	0	-4	0	-4	4	2	2.5	1.5	2.5	0	-150	-250	1.5
80<d≤120	0	-5	0	-5	5	2.5	2.5	2.5	2.5	0	-200	-380	2.5
120<d≤150	0	-7	0	-7	7	3.5	2.5	2.5	2.5	0	-250	-380	2.5
150<d≤180	0	-7	0	-7	7	3,5	5	4	5	0	-250	-380	4
180<d≤250	0	-8	0	-8	8	4	5	5	5	0	-300	-500	5

(1) These differences apply to diameter series 0, 1, 2, 3 and 4 only.
(2) Only applies to ball and grooved bearings
(3) Relates to the ring of isolated bearings for installation in pairs or per unit.

OUTER RING

Units: µm

D (mm)	ΔDmp		ΔDs		VDp(1)	VDp	Kea	Sd(2) Sd1(3)	Sia(2, 3)	Sia1(3)	ΔCs ΔC1s(3)		VCs VC1s(3)
	upper	lower	upper	lower	max	max	max	max	max	max	upper	lower	max
2.5≤D≤6	0	-2.5	0	-2.5	2.5	1.5	1.5	1.5	1.5	3	Identical to ΔBs of the inner ring of the same bearing		1.5
6<D≤18	0	-2.5	0	-2.5	2.5	1.5	1.5	1.5	1.5	3			1.5
18<D≤30	0	-4	0	-4	4	2	2.5	1.5	2.5	4			1.5
30<D≤50	0	-4	0	-4	4	2	2.5	1.5	2.5	4			1.5
50<D≤80	0	-4	0	-4	4	2	4	1.5	4	6			1.5
80<D≤120	0	-5	0	-5	5	2.5	5	2.5	5	7			2.5
120<D≤150	0	-5	0	-5	5	2.5	5	2.5	5	7			2.5
150<D≤180	0	-7	0	-7	7	3.5	5	2.5	5	7			2.5
180<D≤250	0	-8	0	-8	8	4	7	4	7	10			4
250<D≤315	0	-8	0	-8	8	4	7	5	7	10			5
315<D≤400	0	-10	0	-10	10	5	8	7	8	11			7

Note: The tolerances on the outside diameter, D1, of the flange on the outer ring are given in standard ISO 492.
(1) These differences apply to diameter series 0, 1, 2, 3 and 4 only.
(2) Only applies to ball and grooved bearings
(3) Relates to the ring of isolated bearings for installation in pairs or per unit.

Tapered roller bearings – Normal tolerance class

DIAMETER AND RADIAL RUN-OUT – INNER RING

Units: µm

d (mm)	ΔdmpΔdmp		Vdp	Vdmp	Kia
	upper	lower	max	max	max
10≤d≤18	0	-12	12	9	15
18<d≤30	0	-12	12	9	18
30<d≤50	0	-12	12	9	20
50<d≤80	0	-15	15	11	25
80<d≤120	0	-20	20	15	30
120<d≤180	0	-25	25	19	35
180<d≤250	0	-30	30	23	50
250<d≤315	0	-35	35	26	60
315<d≤400	0	-40	40	30	70

DIAMETER AND RADIAL RUN-OUT – INNER RING

Units: µm

D (mm)	ΔDmp		VDp	VDmp	Kea
	upper	lower	max	max	max
18≤D≤≤30	0	-12	12	9	18
30<D≤50	0	-14	14	11	20
50<D≤80	0	-16	16	12	25
80<D≤120	0	-18	18	14	35
120<D≤150	0	-20	20	15	40
150<D≤180	0	-25	25	19	45
180<D≤250	0	-30	30	23	50
250<D≤315	0	-35	35	26	60
315<D≤400	0	-40	40	30	70
400<D≤500	0	-45	45	34	80
500<D≤630	0	-50	50	38	100

The tolerances on the outside diameter (D1) of the flange on the outer ring are given in standard ISO 492.

WIDTH- INNER AND OUTER RINGS, SINGLE-ROW BEARINGS AND SINGLE-ROW SUB-ASSEMBLIES

Units: µm

d (mm)	ΔBs		ΔCs		ΔTs		ΔT1s		ΔT2s	
	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
10≤d≤18	0	-120	0	-120	+200	0	+100	0	+100	0
18<d≤30	0	-120	0	-120	+200	0	+100	0	+100	0
30<d≤50	0	-120	0	-120	+200	0	+100	0	+100	0
50<d≤80	0	-150	0	-150	+200	0	+100	0	+100	0
80<d≤120	0	-200	0	-200	+200	-200	+100	-100	+100	-100
120<d≤180	0	-250	0	-250	+350	-250	+150	-150	+200	-100
180<d≤250	0	-300	0	-300	+350	-250	+150	-150	+200	-100
250<d≤315	0	-350	0	-350	+350	-250	+150	-150	+200	-100
315<d≤400	0	-400	0	-400	+400	-400	+200	-200	+200	-200

High precision tapered roller bearings – Tolerance class 6X

The diameter and radial run-out tolerances of inner rings (cones) and outer rings (cups) in this tolerance class are the same as those given in page 54 for the normal class. The width tolerances are given below.

WIDTH – INNER AND OUTER RINGS, SINGLE-ROW BEARINGS AND SINGLE-ROW SUB-ASSEMBLIES.

Units: µm

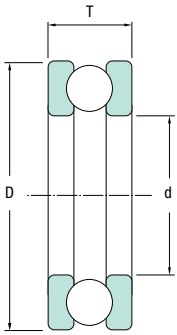
d (mm)	ΔBs		ΔCs		ΔTs		ΔT1s		ΔT2s	
	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
10≤d≤18	0	-50	0	-100	+100	0	+50	0	+50	0
18<d≤30	0	-50	0	-100	+100	0	+50	0	+50	0
30<d≤50	0	-50	0	-100	+100	0	+50	0	+50	0
50<d≤80	0	-50	0	-100	+100	0	+50	0	+50	0
80<d≤120	0	-50	0	-100	+100	0	+50	0	+50	0
120<d≤180	0	-50	0	-100	+150	0	+50	0	+100	0
180<d≤250	0	-50	0	-100	+150	0	+50	0	+100	0
250<d≤315	0	-50	0	-100	+200	0	+100	0	+100	0
315<d≤400	0	-50	0	-100	+200	0	+100	0	+100	0

Ball thrust bearings – Normal tolerance class

Standard ISO 199.

REFERENCES

d	Nominal bore diameter of the shaft ring of a single-direction thrust bearing
Δdmp	Deviation in the mean bore diameter of the shaft ring of a single-direction thrust bearing, in an isolated plane
Vdp	Variation in the bore diameter of the shaft ring of a single-direction thrust bearing, in an isolated radial plane
D	Nominal outside diameter of the housing ring
ΔDmp	Deviation in the mean outside diameter of the housing ring in an isolated plane
VDp	Variation in the outside diameter of the housing ring in an isolated radial plane
Si	Variation in thickness between the bearing raceway and the contact face of the shaft ring
Se	Variation in thickness between the bearing raceway and the contact face of the housing ring
ΔTs	Variation in total height



SHAFT RING AND HEIGHT OF THRUST BEARING

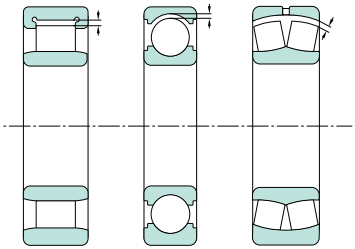
Units: µm

d (mm)		Δdmp		Vdp	Si	ΔTs	
>	≤	upper	lower	max	max	upper	lower
-	18	0	-8	6	10	+20	-250
18	30	0	-10	8	10	+20	-250
30	50	0	-12	9	10	+20	-250
50	80	0	-15	11	10	+20	-300
80	120	0	-20	15	15	+25	-300
120	180	0	-25	19	15	+25	-400
180	250	0	-30	23	20	+30	-400
250	315	0	-35	26	25	+40	-400
315	400	0	-40	30	30	+40	-500
400	500	0	-45	34	30	+50	-500

Internal radial clearance is the load free displacement of one ring with respect to the other in radial direction.

RADIAL CLEARANCE OF RADIAL CONTACT BEARINGS. DEFINITION

The internal radial clearance is the load-free displacement of one ring with respect to the other in the radial direction.



Radial clearance		Bearing designation	Other manufactures
Type	Group	Codex suffix	
Normal clearance	N		Suitable for low or moderate loads, normal interference fit of only one of the two rings, normal temperatures.
Increased clearance	3	C3	Clearance commonly used in the following cases: • Tight interference fit • Possible misalignment, bending of shaft • To increase the contact angle of highly-loaded radial contact ball bearings • High temperatures
	4 5	C4 C5	Clearance groups 4 and 5 are used in the above cases when group 3 is insufficient.
Reduced clearance	2	C2	This clearance group is used (rarely) when very good guidance with reduced clearance is required, and in applications with alternating loads and high impact levels. The use of this clearance group is highly particular, because its aim is usually to cancel the bearing operating clearance.