701-8600

Drawn Cup Needle Roller Bearings

NTN Drawn Cup Needle Roller Bearings comprise an outer ring (formed by precision deep-drawing of thin steel sheet) and needle rollers and a cage that are fit into the surface-hardened raceway surface provided on the outer ring (Drawn-cup). This bearing type boasts the smallest cross-sectional height of bearings having an outer ring, which contributes to reduced bearing space and cost.

Usually, this bearing type, lacking an inner ring, is incorporated into a design that uses a shaft directly as a raceway surface; **its outer ring is designed to be inseparable from the needle rollers and cage.** Thus, the bearing is press-fit into a rigid housing with adequate fit and requires no further axial location with a locating snap ring or the like.

Types and designs

NTN Drawn Cup Needle Roller Bearings can be classified into open-end and closed-end types according to the form of their outer ring.

The open-end design is further subcategorized into the **series HK** (metric standard series), **series HMK** (heavy load series), and **series DCL** (inch series).

The closed-end design is further classified into **series BK** (metric standard series) and **series HCK** (full-complement type lacking a cage, for use with universal joints only).

Bearings of greater width in the **series HK, HMK,** and **BK** are available as double-row configurations (suffix **ZW**) having needle rollers arranged in two rows.

Fig. 1 Series HK (HMK) Fig. 2 Series HK·ZWD (HMK·ZWD)

Fig. 3 Series BK Fig. 4 Series HCK
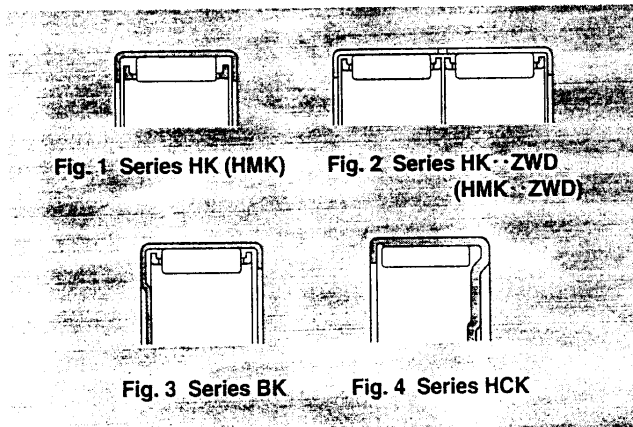
Sealed NTN Drawn Cup Needle Roller Bearings (suffix **L** or **LL**) having a synthetic rubber seal on one or both ends are pre-filled with lithium soap grease. The allowable operating temperature range with this bearing variant is −25°C to +100°C. Its rollers are shorter than those in an open-ended type of the same dimension, so its load rating is accordingly smaller.

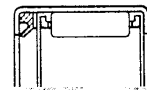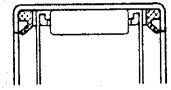Fig. 5 Series HK··L   Fig. 6 Series HK··LL
         (HMK··L)   (HMK··LL)

The cages used for drawn cup needle roller bearings are usually pressed-steel cages (suffix **C**) or welded cages (suffix omitted).

Also, certain small drawn cup needle roller bearings use molded polyamide cages reinforced with glass fiber or carbon fiber (suffix **T2**). The **T2** cage features a maximum allowable operating temperature of 120°C and a maximum allowable continuous operating temperature of 100°C.

Interpreting bearing numbers

As summarized in **Fig. 7**, the bearing numbers of NTN Drawn Cup Needle Roller Bearings comprise a series number, dimension code (inscribed enveloping circle diameter × width dimension), and suffix.

HK 3020 LL

Seal code
Dimension code
Series number

Fig. 7
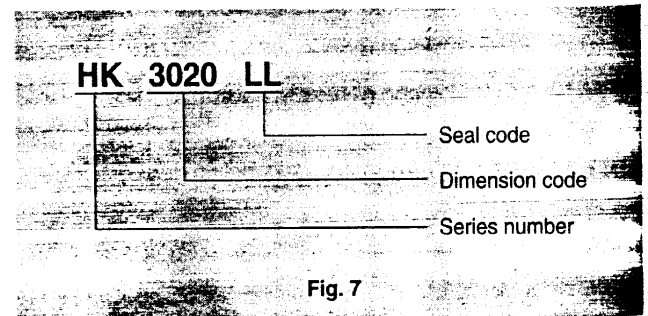
Bearing fits

The fit of an **NTN** Drawn Cup Needle Roller Bearing to a housing is usually a tight fit where the inscribed enveloping circle diameter (F_w) of press-fit rollers satisfies ISO tolerance class F8. However, the inscribed enveloping circle diameter (F_w) of press-fit rollers varies with the material and rigidity of the housing. Therefore, actual bearing fit (interference) should be measured and determined through trials before the bearing is mounted.

If a housing has sufficient rigidity, selecting a fit to housing or shaft from **Table 1** can result in an inscribed enveloping circle diameter (F_w) of press-fit rollers close to F8 and a radial clearance close to normal clearance.

Table 1 Fit to housing and shaft

Series number	Housing		Shaft	
	Steel	Light alloy	Without inner ring	With inner ring
HK,BK	N6 (N7)	R6 (R7)	h5 (h6)	k5 (j6)
HMK,DCL	J6 (J7)	M6 (M7)		
HCK	F7	—	k6	—

Housing bore accuracy

Because the outer ring has a thinner wall, the performance of drawn cup needle roller bearings is significantly affected by the surface roughness and the dimensional and form accuracy of the housing bore to which a bearing is press-fit. The housing bore must satisfy the accuracy of **Table 2**. For the accuracy of a shaft that is used directly as a raceway surface or that uses an inner ring, refer to **Sec. 14.3 "Shaft and housing accuracy"** on page A-59.

Table 2 Housing bore accuracy

Characteristics	Tolerance
Circularity (max.)	IT4 or less
Cylindricity (max.)	IT4 or less
Surface roughness (max.)	1.6a

Mounting practices

The press-fitting of an **NTN** Drawn Cup Needle Roller Bearing into a housing requires the placement of a jig on the marked side of the bearing side face.

Never directly strike a bearing with a hammer when installing it. To reliably mount a bearing so that it is not misaligned or mispositioned, use a press-fit jig comprising a mandrel, fitted with an O-ring as shown in **Fig. 8**.

Because an **NTN** Drawn Cup Needle Roller Bearing is located with a housing, it is not necessary to use a snap ring or provide a shouldered section. However, if it is to be press-fit into a shouldered housing, special care must be taken to prevent the bearing side face from interfering with the shoulder and the bearing from being deformed.
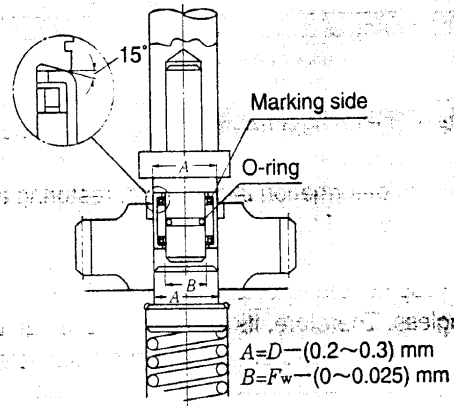

$A=D-(0.2\sim0.3)$ mm
$B=F_w-(0\sim0.025)$ mm

Fig. 8

NTN series HCK bearings for universal joints are crimped to a yoke with a special assembler (**Fig. 9**). The hardness of the yoke must not exceed HRC30. For information about the special assembler (Model IPH), contact **NTN** Engineering.
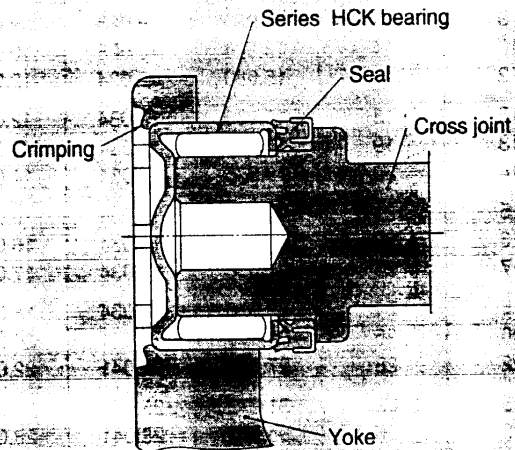

Fig. 9

Bearing tolerances and measuring methods

The outer ring of a drawn cup needle roller bearing is thin-walled. Therefore, some deformation of the outer ring unavoidably develops during the manufacturing process, particularly during heat treatment. However, when the outer ring is press-fit into a correctly dimensioned housing, the deformation is corrected, restoring the design functions of the outer ring.

For this reason, measuring the dimensional accuracy of a drawn cup needle roller bearing before it is press-fit is meaningless. Therefore, its accuracy is evaluated by measuring its inscribed enveloping circle diameter (F_w)

after it has been press-fit into a ring gauge of correct dimensions (wall thickness 20 mm or greater).

The tolerances of the bore diameter of the ring gauges and the inscribed enveloping circle diameter (F_w) are given in **Tables 3** to **6**, which apply to the **series HK** and **BK** (standard metric series), **series HMK** (heavy load series), **series DCL** (inch series), and **series HCK** (for universal joints). When measuring the inscribed enveloping circle diameter (F_w) with a plug gauge, the dimension at GO side must satisfy "Low" tolerance for inscribed enveloping circle diameter, and that at NO GO side must satisfy "Height" tolerance plus 2 μm. These values comply with the relevant ISO standard.

Table 3 Enveloping circle diameter tolerance (series HK and BK)

Unit: mm

Enveloping circle dia. F_w	Outside dia. of outer ring D	Ring gauge bore dia.	Enveloping circle dia. tolerance	
			High	Low
3	6.5	6.484	3.016	3.006
4	8	7.984	4.022	4.010
5	9	8.984	5.022	5.010
6	10	9.984	6.022	6.010
7	11	10.980	7.028	7.013
8	12	11.980	8.028	8.013
9	13	12.980	9.028	9.013
10	14	13.980	10.028	10.013
12	16	15.980	12.034	12.016
12	18	17.980	12.034	12.016
13	19	18.976	13.034	13.016
14	20	19.976	14.034	14.016
15	21	20.976	15.034	15.016
16	22	21.976	16.034	16.016
17	23	22.976	17.034	17.016
18	24	23.976	18.034	18.016
20	26	25.976	20.041	20.020
22	28	27.976	22.041	22.020
25	32	31.972	25.041	25.020
28	35	34.972	28.041	28.020
30	37	36.972	30.041	30.020
35	42	41.972	35.050	35.025
40	47	46.972	40.050	40.025
45	52	51.967	45.050	45.025
50	58	57.967	50.050	50.025
55	63	62.967	55.060	55.030
60	68	67.967	60.060	60.030

Table 4 Enveloping circle diameter tolerance (series HMK)

Unit: mm

Enveloping circle dia. F_w	Outside dia. of outer ring D	Ring gauge bore dia.	Enveloping circle dia. tolerance	
			High	Low
8	15	14.995	8.028	8.013
9	16	15.995	9.028	9.013
10	17	16.995	10.028	10.013
12	19	18.995	12.034	12.016
14	22	21.995	14.034	14.016
15	22	21.995	15.034	15.016
16	24	23.995	16.034	16.016
17	24	23.995	17.034	17.016
18	25	24.995	18.034	18.016
19	27	26.995	19.041	19.020
20	27	26.995	20.041	20.020
21	29	28.995	21.041	21.020
22	29	28.995	22.041	22.020
24	31	30.994	24.041	24.020
25	33	32.994	25.041	25.020
26	34	33.994	26.041	26.020
28	37	36.994	28.041	28.020
29	38	37.994	29.041	29.020
30	40	39.994	30.041	30.020
32	42	41.994	32.050	32.025
35	45	44.994	35.050	35.025
37	47	46.994	37.050	37.025
38	48	47.994	38.050	38.025
40	50	49.994	40.050	40.025
45	55	54.994	45.050	45.025
50	62	61.994	50.050	50.025

Table 5 Enveloping circle diameter tolerance (series DCL)

Unit: mm

Enveloping circle dia. F_w	Outside dia. of outer ring D	Ring gauge bore dia.	Enveloping circle dia. tolerance	
			High	Low
6.350	11.112	11.125	6.411	6.388
7.938	12.700	12.713	7.998	7.976
9.525	14.288	14.300	9.586	9.563
11.112	15.875	15.888	11.173	11.151
12.700	17.462	17.475	12.761	12.738
14.288	19.050	19.063	14.348	14.326
15.875	20.638	20.650	15.936	15.913
17.462	22.225	22.238	17.523	17.501
19.050	25.400	25.387	19.086	19.063
20.638	26.988	26.975	20.673	20.650
22.225	28.575	28.562	22.261	22.238
23.812	30.162	30.150	23.848	23.825
25.400	31.750	31.737	25.436	25.413
26.988	33.338	33.325	27.023	27.000
28.575	34.925	34.912	28.611	28.588
30.162	38.100	38.087	30.198	30.175
31.750	38.100	38.087	31.786	31.763
34.925	41.275	41.262	34.963	34.938
38.100	47.625	47.612	38.141	38.113
41.275	50.800	50.787	41.316	41.288
44.450	53.975	53.962	44.493	44.463
47.625	57.150	57.137	47.668	47.638
50.800	60.325	60.312	50.846	50.815

Table 6 Enveloping circle diameter tolerance (series HCK)

Unit: mm

Enveloping circle dia. F_w	Outside dia. of outer ring D	Ring gauge bore dia.	Enveloping circle dia. tolerance	
			High	Low
10	15	15.016	10.026	10.011
11.656	17.1	17.116	11.687	11.669
13	19	19.020	13.031	13.013
14	20	20.020	14.031	14.013
16	22	22.020	16.031	16.013
18	24	24.020	18.031	18.013
18	24.6	24.620	18.031	13.013
20	27.9	27.920	20.038	20.017

Type HK, Type HK··ZWD
Type HMK
Type BK, Type BK··ZWD
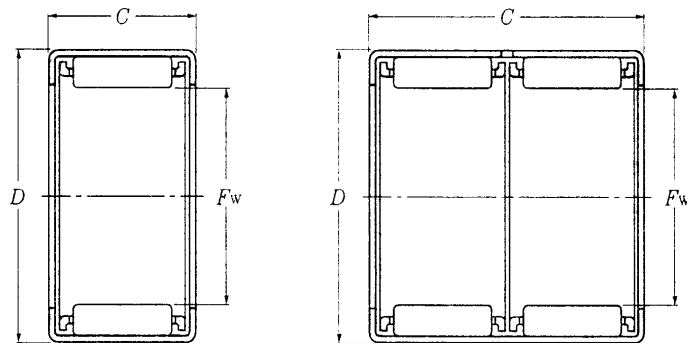
Type HK, Type HMK   Type HK··ZWD
(Open end design)

F_W 16~20mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers		Mass	Appropriate[1] inner ring
	mm			dynamic	static	dynamic	static	rpm				kg	
				N		kgf		grease	oil	open end design	closed end design		
F_W	D	C 0 -0.2	C_1 max	C_r	C_{or}	C_r	C_{or}					(approx.)	(as a reference)
16	22	12	2.7	7 750	9 700	795	990	10 000	15 000	—	BK1612	0.014	IR12×16×13
	22	16	—	11 100	15 300	1 130	1 570	10 000	15 000	HK1616	—	0.016	IR12×16×20
	22	16	2.7	11 100	15 300	1 130	1 570	10 000	15 000	—	BK1616	0.018	IR12×16×20
	22	22	—	13 300	19 400	1 360	1 980	10 000	15 000	HK1622ZWD	—	0.022	—
	22	22	2.7	13 300	19 400	1 360	1 980	10 000	15 000	—	BK1622ZWD	0.023	—
	24	16	—	12 400	13 500	1 260	1 370	10 000	15 000	HMK1616	—	0.021	IR12×16×20
	24	20	—	15 600	18 200	1 590	1 860	10 000	15 000	HMK1620	—	0.027	IR12×16×22
17	23	12	—	8 500	11 100	865	1 130	9 500	14 000	HK1712	—	0.012	—
	23	12	2.7	8 500	11 100	865	1 130	9 500	14 000	—	BK1712	0.015	—
	24	15	—	12 100	15 000	1 230	1 530	9 500	14 000	HMK1715	—	0.018	IR14×17×17
	24	20	—	15 200	20 000	1 540	2 040	9 500	14 000	HMK1720C	—	0.024	IR12×17×20.5
	24	25	—	19 300	27 400	1 970	2 790	9 500	14 000	HMK1725	—	0.030	IR12×17×25.5
18	24	12	—	8 300	10 900	845	1 110	8 500	13 000	HK1812	—	0.013	IR15×18×12.5
	24	12	2.7	8 300	10 900	845	1 110	8 500	13 000	—	BK1812	0.015	IR15×18×12.5
	24	16	—	11 800	17 300	1 210	1 760	8 500	13 000	HK1816	—	0.018	IR15×18×16.5
	24	16	2.7	11 800	17 300	1 210	1 760	8 500	13 000	—	BK1816	0.020	IR15×18×16.5
	25	13	—	10 200	12 200	1 040	1 240	8 500	13 000	HMK1813	—	0.016	IR15×18×16
	25	15	—	12 000	15 100	1 220	1 540	8 500	13 000	HMK1815	—	0.019	IR15×18×16
	25	17	—	13 800	18 000	1 400	1 830	8 500	13 000	HMK1817	—	0.021	IR15×18×17.5
	25	19	—	15 500	20 900	1 580	2 130	8 500	13 000	HMK1819	—	0.024	IR15×18×20.5
	25	20	—	16 300	22 300	1 660	2 280	8 500	13 000	HMK1820	—	0.025	IR15×18×20.5
	25	25	—	20 300	29 600	2 070	3 000	8 500	13 000	HMK1825	—	0.031	IR15×18×25.5
19	27	16	—	13 900	16 300	1 410	1 660	8 500	13 000	HMK1916	—	0.025	IR15×19×20
	27	20	—	17 500	22 100	1 790	2 250	8 500	13 000	HMK1920	—	0.031	—
20	26	12	—	9 250	13 000	945	1 330	8 000	12 000	HK2012C	—	0.014	IR15×20×13
	26	12	2.7	9 250	13 000	945	1 330	8 000	12 000	—	BK2012	0.017	IR15×20×13
	26	16	—	13 000	20 100	1 320	2 050	8 000	12 000	HK2016	—	0.019	IR17×20×16.5
	26	16	2.7	13 000	20 100	1 320	2 050	8 000	12 000	—	BK2016	0.022	IR17×20×16.5
	26	20	—	16 400	27 100	1 670	2 760	8 000	12 000	HK2020C	—	0.024	IR17×20×20.5
	26	20	2.7	16 400	27 100	1 670	2 760	8 000	12 000	—	BK2020C	0.027	IR17×20×20.5

NOTE : 1) For bearing with an inner ring, part number is clarified as **HK + IR**. (See page B-180,181 for the inner ring dimension table.)

Type IR

d 10~15mm

	Boundary dimensions				Bearing numbers	Abutment dimensions		Mass
		mm					mm	kg
d	$F^{1)}$	B	$r_{s\,min}{}^{2)}$	t		d_a min	r_{as} max	(approx.)
10	15	15.5	0.3	1	**IR10×15×15.5**	12	0.3	0.012
	15 $^{0}_{-0.008}$	20.5	0.3	1	**IR10×15×20.5**	12	0.3	0.015
	16	16	0.3	1	**IR10×16×16**	12	0.3	0.015
12	15	12	0.3	1	**IR12×15×12**	14	0.3	0.0058
	15	12.5	0.3	1	**IR12×15×12.5**	14	0.3	0.0061
	15	16	0.3	1	**IR12×15×16**	14	0.3	0.0078
	15	16.5	0.3	—	**※IR12×15×16.5**	14	0.3	0.0080
	15	22.5	0.3	—	**※IR12×15×22.5**	14	0.3	0.011
	16	12	0.3	1.5	**IR12×16×12**	14	0.3	0.0079
	16 $_{0}$	13	0.3	1.5	**IR12×16×13**	14	0.3	0.0087
	16 $^{-0.008}$	14	0.3	—	**※IR12×16×14D**	14	0.3	0.0095
	16	16	0.3	1.5	**IR12×16×16**	14	0.3	0.011
	16	20	0.3	1.5	**IR12×16×20**	14	0.3	0.014
	16	22	0.3	1.5	**IR12×16×22**	14	0.3	0.015
	17	20.5	0.3	1.5	**IR12×17×20.5**	14	0.3	0.019
	17	25.5	0.3	1.5	**IR12×17×25.5**	14	0.3	0.024
	18	16	0.3	1.5	**IR12×18×16**	14	0.3	0.018
14	17 $^{0}_{-0.008}$	17	0.3	1.5	**IR14×17×17**	16	0.3	0.0095
15	18	12.5	0.3	1.5	**IR15×18×12.5**	17	0.3	0.0072
	18	16	0.3	1.5	**IR15×18×16**	17	0.3	0.0093
	18 $_{0}$	16.5	0.3	1.5	**IR15×18×16.5**	17	0.3	0.0096
	18 $^{-0.008}$	17.5	0.3	1.5	**IR15×18×17.5**	17	0.3	0.010
	18	20.5	0.3	1.5	**IR15×18×20.5**	17	0.3	0.012
	18	25.5	0.3	1.5	**IR15×18×25.5**	17	0.3	0.015
	19	16	0.3	1.5	**IR15×19×16**	17	0.3	0.013
	19	20	0.3	1.5	**IR15×19×20**	17	0.3	0.016
	20	12	0.3	1.5	**IR15×20×12**	17	0.3	0.012
	20 $_{0}$	13	0.3	1.5	**IR15×20×13**	17	0.3	0.014
	20 $^{-0.009}$	14	0.3	—	**※IR15×20×14D**	17	0.3	0.015
	20	18	0.3	1.5	**IR15×20×18**	17	0.3	0.019
	20	20.5	0.3	1.5	**IR15×20×20.5**	17	0.3	0.021

Notes: 1) The tolerance for this dimension provides regular clearance when an inner ring is combined with a needle roller bearing that lacks an inner ring.

d 15~20mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass
		mm					mm	kg
d	F [1]	B	$r_{s\,min}$ [2]	t		d_a min	r_{as} max	(approx.)
15	20	23	0.3	—	※IR15×20×23	17	0.3	0.024
	20 ⁰	26	0.3	1.5	IR15×20×26	17	0.3	0.027
	20 ₋₀.₀₀₉	30.5	0.3	1.5	IR15×20×30.5	17	0.3	0.032
	22	20	0.6	1.5	IR15×22×20	19	0.6	0.032
17	20	16	0.3	1.5	IR17×20×16	19	0.3	0.011
	20	16.5	0.3	1.5	IR17×20×16.5	19	0.3	0.011
	20	20	0.3	1.5	IR17×20×20	19	0.3	0.014
	20	20.5	0.3	—	※IR17×20×20.5	19	0.3	0.014
	20	30.5	0.3	—	※IR17×20×30.5	19	0.3	0.021
	21	16	0.3	1.5	IR17×21×16	19	0.3	0.014
	21	20	0.3	—	※IR17×21×20	19	0.3	0.018
	22 ⁰	13	0.3	1.5	IR17×22×13	19	0.3	0.015
	22 ₋₀.₀₀₉	14	0.3	—	※IR17×22×14D	19	0.3	0.016
	22	16	0.3	—	※IR17×22×16	19	0.3	0.019
	22	18	0.3	1.5	IR17×22×18	19	0.3	0.021
	22	20.5	0.3	1.5	IR17×22×20.5	19	0.3	0.024
	22	23	0.3	—	※IR17×22×23	19	0.3	0.027
	22	26	0.3	1.5	IR17×22×26	19	0.3	0.030
	22	32	0.3	1.5	IR17×22×32	19	0.3	0.036
	24	20	0.6	1.5	IR17×24×20	21	0.6	0.034
20	24	16	0.3	1.8	IR20×24×16	22	0.3	0.017
	24	20	0.3	—	※IR20×24×20	22	0.3	0.021
	24	28.5	0.3	—	※IR20×24×28.5	22	0.3	0.030
	25	12.5	0.3	1.8	IR20×25×12.5	22	0.3	0.016
	25	16	0.3	—	※IR20×25×16	22	0.3	0.021
	25 ⁰	16.5	0.3	1.8	IR20×25×16.5	22	0.3	0.022
	25 ₋₀.₀₀₉	17	0.3	1.8	IR20×25×17	22	0.3	0.022
	25	18	0.3	—	※IR20×25×18D	22	0.3	0.024
	25	20	0.3	—	※IR20×25×20	22	0.3	0.027
	25	20.5	0.3	1.8	IR20×25×20.5	22	0.3	0.028
	25	23	0.3	1.8	IR20×25×23	22	0.3	0.031

Notes: 1) The tolerance for this dimension provides regular clearance when an inner ring is combined with a needle roller bearing that lacks an inner ring.