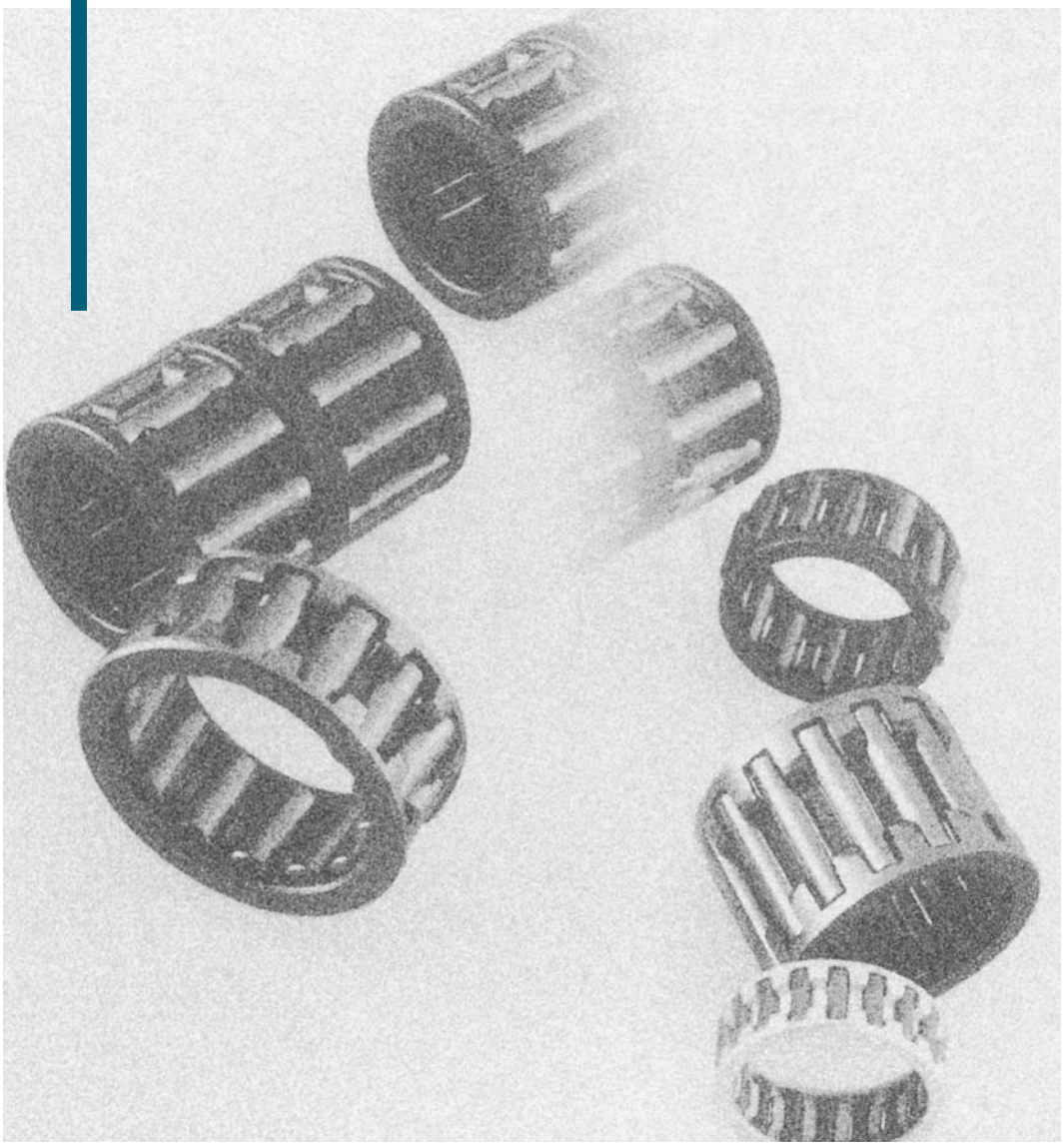
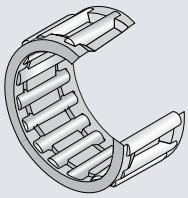
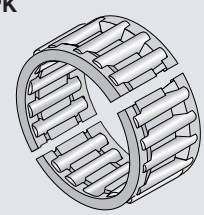
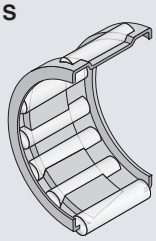
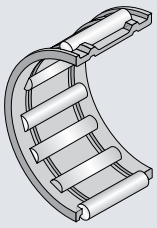
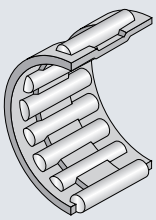
Needle Roller and Cage Assemblies for connecting rod bearings



Needle Roller and Cage Assemblies for connecting rod bearings

These needle roller and cage assemblies are specially designed so as to be adaptable to the operating environmental conditions for the connecting rods of small and medium reciprocal engines and compressors.

The connecting rods are used under a severe operating condition wherein acting load magnitude and direction fluctuate rapidly as well as under an high temperature and strict lubrication environment. Therefore, special measures are manly undertaken for the cage structure, material and machining method so that the needle roller and cage assemblies are resistible to the said operating condition and environment.

Type of needle roller and cage assembly	Location	Cage type	Applicable shaft diameter (mm)	Composition of bearing number
PK 	Large end side	Machined ring type	ϕ10 – ϕ38	**PK 20×26×13.8 X1** Suffix Width Roller set outer diameter Roller set bore diameter Type code
GPK 		Machined type Split type	ϕ10 – ϕ38	**GPK 20 × 26 × 13.8 X** Suffix Width Roller set outer diameter Roller set bore diameter Type code
KMJ··S 		Welded type	ϕ10 – ϕ38	**KMJ 10 × 14 × 8.8 S** Suffix Width Roller set outer diameter Roller set bore diameter Type code
KBK 	Small end side	Machined ring type	ϕ7 – ϕ25	**KBK 14 × 18 × 17** Width Roller set outer diameter Roller set bore diameter Type code
KV··S 		Welded type	ϕ7 – ϕ100	**KV 8 × 11 × 8 S V4** Suffix Suffix Width Roller set outer diameter Roller set bore diameter Type code

Data for the GPK, KMJ··S, KV··S types are not included in the dimension table. For detailed information, contact **NTN** Engineering.

Bearing number	Code items and respective dimensions	Remarks
PK20×26×13.8X1	Roller set bore diameter : ϕ20 Roller set outer diamete r: ϕ26 Width : 13.8 X1 : numbered entry	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.
GPK20× 26 ×13.8X	Roller set bore diameter : ϕ20 Roller set outer diameter : ϕ26 Width :13.8 X : numbered entry	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc. Can be applied to a crank of integral structure.
KMJ10×14×8.8S	Roller set bore diameter : ϕ10 Roller set outer diameter : ϕ14 Width :8.8 S : welded type	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.
KBK14×18×17	Roller set bore diameter : ϕ14 Roller set outer diameter : ϕ18 Width : 17	Type KBK is intended to guide inner ring, which of the guide surface is designed as long as possible to thereby reduce the surface pressure. In addition, the roller length is so designed as to be maximum against the width of connecting rod, for high load capacity. On the other hand, Type V••S intended for outer ring guide needs a guide along the bore surface of connecting rod.
KV8×11×8SV4	Roller set bore diameter : ϕ8 Roller set outer diameter : ϕ11 Width : 8 S : welded type V4 : Special specification	

Radial clearance

Table 1 shows the recommended clearance values though the radial clearance differs depending on bearing clearance, load, revolutions and ambient temperature.

The proper radial clearance can be got by proper selection and combination of roller diameter, connecting rod hole diameter and pin diameter. **Table 2** shows the examples of selection and combination of those.

Table 1 Recommended clearance values

Unit : μm

Pin diameter mm Over	incl.	Large end side	Small end side
6	10	9～23	5～17
10	18	10～24	5～17
18	30	10～24	5～17
30	40	18～33	—

Table 2 Radial clearance values obtainable by selection and combination

Case of needle roller and cage assembly Type PK for crank pin
Crank pin hole diameter 22mm H6 (0 to +13 μm)
Crank pin diameter 14mm h5 (0 to -8 μm)

Unit : μm

Pin diameter sorting class \ Hole diameter sorting class	0～+4	+4～+8	+8～+13
Sorting class of needle roller used	−4～−6	−2～−4	0～−2
0～−3	10～17	10～17	10～18
−3～−6	13～20	13～20	13～21
−6～−8	16～22	16～22	16～23

Connecting rod and pin specifications

Connecting rod (bore surface), crank pin and piston pin (outer surface) can be used as direct raceway surface. However, these surfaces must be resistible to great load while maintaining high accuracy. For that, connecting rods and pins acting as the direct raceway surface must comply with the specifications specified hereunder.

Any connecting rods shall be made of cement steel, e.g. chrome molybdenum steel (SCM415, etc.), nickel chrome molybdenum steel (SNCM420, etc.) and any crank pins and piston pins shall also be made of cement steel, e.g. chrome steel (SCr420, etc.), all of which shall be surface-hardened by carburizing.

The surface hardness of each shall range from HRC58 to 64 and adequate depth of effective carburizing-hardened layer shall be secured up to Hv550. The depth of effective carburizing-hardened layer differs depending on actual load and pin diameter.

Feel free to contact **NTN** for the more detailed information.

The respective profile accuracy of connecting rod hole, crank and piston pin outer surfaces shall be as specified in **Table 3**.

Furthermore, the parallelism of crank pin and piston pin shall be 0.02mm or less against 100mm. (**Fig. 1**)

The surface roughness shall be 0.2a for connecting rod and 0.1a for pin outer surface as a guideline.

Table 3 Recommended accuracy of connecting rod and pin

Unit : μm

Parts	Characteristics	Pin diameter classification mm ～14	14～18	18～25	25～30	30～40
Connecting rod	Roundness (max)	3	4	4	5	5
	Cylindricality (max)	2	3	3	4	4
Pin	Roundness (max)	2	2	3	3	4
	Cylindricality (max)	1	1	2	2	3

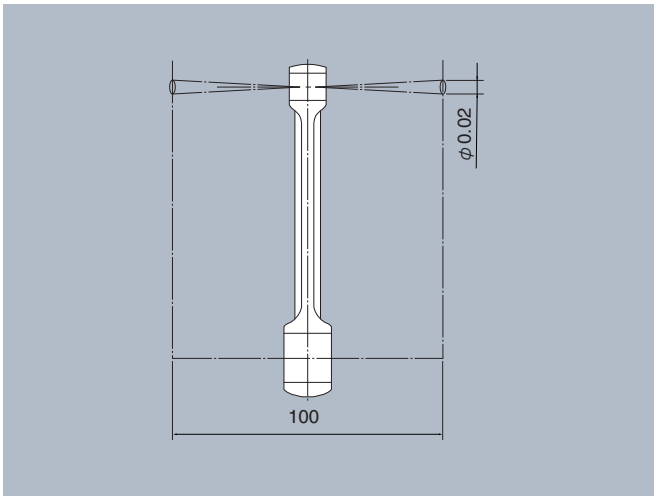


Fig. 1

Regulation to connecting rod

Two methods are available as follows to regulate axial motion of a connecting rod; one method is to make smaller a clearance between the rod and crank web at large end side (Method of regulating at large end side) and another method is to narrow a clearance between the rod and piston boss at the small end side (Method of regulating at small end side).

In general, the method of regulation at large end side is mostly adopted to get accurate motion of a connecting rod.

On the other hand, the method of regulation at small end side is adopted when regulation at large end side disables to secure good lubrication to the bearing and the guide surface at large end side due to short connecting rod and comparatively high revolutions.

Regulation at large end side

This method regulates axial motion of a connecting rod by forming a sliding surface between the large end of the connecting rod and the side face of crank web. For the use of this method, however, the connecting rod must be provided, on its bore surface, with oil hole, slot and oil groove to feed lubrication oil in and onto the bearing and guide surface at large end side.

The crank web end face shall be surface-hardened as necessary or otherwise a side washer of copper alloy or hardened steel shall be fitted on the guide surface.

On the other hand, the needle roller and cage assembly at small end side shall be guided in axial direction by the side face of piston boss. A great play shall be secured between the piston boss and the connecting rod.

Regulation at small end side

This method regulates axial motion at the small end face of a connecting rod and the side face of a piston rod. Generally a connecting rod is not provided with oil groove and slot to lubricate the guide surface at small end side, but on occasion it is surface-hardened and uses a side washer.

Usually a connecting rod shall be provided with a through-hole (at its small end side) to lubricate the bearing unit.

On the other hand, at the large end side a free clearance exists between the connecting rod and the crank web and, therefore, generally special measures such as oil groove to lubricate, etc.

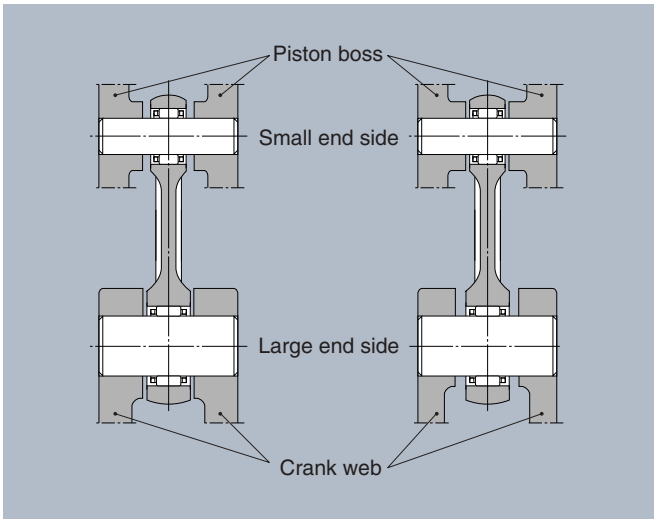
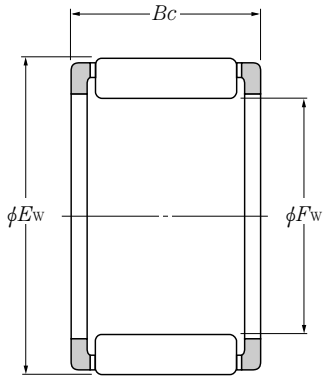


Fig. 2. Regulation at large end side Fig. 3 Regulation at small end side

For crank-pin

Type PK



F_w 10～28mm

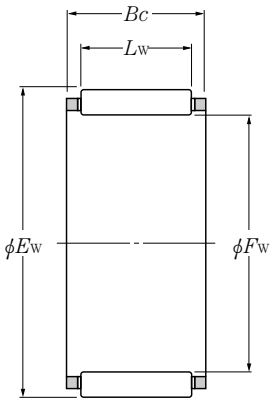
Boundary dimensions mm			Basic load ratings N		Basic load ratings kgf		Bearing numbers	Mass kg
F_w	E_w	B_c $^{0}_{-0.2}$	dynamic C_r	static C_{or}	dynamic C_r	static C_{or}		(approx.)
10	14	9.8	5 050	4 900	515	500	**PK10×14×9.8X14**	0.0037
12	16	10	5 450	5 600	555	570	**PK12×16×10.2**	0.0044
	17	9.8	6 800	6 550	695	670	**PK12×17×9.8X15**	0.0053
14	19	9.7	7 300	7 400	745	755	**PK14×19× 9.7X1**	0.0065
	19	11.8	8 200	8 600	840	880	**PK14×19×11.8X1**	0.0070
	20	11.8	19 100	10 000	1 030	1020	**PK14×20×11.8X3**	0.0091
15	20	9.8	7 250	7 450	740	760	**PK15×20× 9.8X**	0.0067
	21	11.8	10 000	10 200	1 020	1 040	**PK15×21×11.8X8**	0.0095
16	22	11.8	10 000	10 300	1 020	1 050	**PK16×22×11.8X2**	0.0097
	22	13.2	10 900	11 500	1 110	1 170	**PK16×22×13.2X**	0.0110
18	24	11.8	11 300	12 400	1 150	1 260	**PK18×24×11.8X3**	0.0110
	24	13.3	13 300	15 300	1 360	1 560	**PK18×24×13.3X1**	0.0120
19	24	13.9	11 900	15 200	1 220	1 550	**PK19×24×13.9X**	0.0110
	25	15.8	14 300	17 000	1 460	1 730	**PK19×25×15.8X1**	0.0150
20	26	13.8	14 000	16 700	1 420	1 700	**PK20×26×13.8X6**	0.0140
22	28	15.8	15 900	20 200	1 620	2 060	**PK22×28×15.8X1**	0.0170
	29	17.8	18 800	22 800	1 920	2 320	**PK22×29×17.8X7**	0.0240
	30	14.7	16 900	18 200	1 720	1 860	**PK22×30×14.7X2**	0.0240
	30	17.8	21 900	25 400	2 230	2 590	**PK22×30×17.8X2**	0.0270
24	31	16.8	20 800	26 600	2 120	2 710	**PK24×31×16.8X7**	0.0240
	32	19.8	22 900	27 500	2 340	2 810	**PK24×32×19.8X6**	0.0330
26	31	13.8	14 200	20 900	1 450	2 130	**PK26×31×13.8X31**	0.0139
	32	13.8	16 400	22 200	1 670	2260	**PK26×32×13.8X**	0.0180
	34	16.8	21 600	26 100	2 200	2 660	**PK26×34×16.8X7**	0.0320
27	36	20.8	30 500	38 500	3 150	3 950	**PK27×36×20.8X1**	0.0440
28	35	14	18 400	23 700	1 880	2 420	**PK28×35×13.8X1**	0.0226
	36	14	20 600	25 100	2 100	2 560	**PK28×36×13.8X4**	0.0250

F_w 28～38mm

Boundary dimensions mm			Basic load ratings N dynamic		kgf dynamic		Bearing numbers	Mass kg
F_w	E_w	B_c $^{0}_{-0.2}$	C_r	static C_{or}	C_r	static C_{or}		(approx.)
28	36	15.8	23 700	30 000	2 410	3 050	**PK28×36×15.8X6**	0.0310
	37	20.8	32 500	41 500	3 300	4 250	**PK28×37×20.8X**	0.0480
29	39	21.4	32 500	39 500	3 300	4 000	**PK29×39×21.4X2**	0.0550
30	37	15.9	21 900	30 500	2 230	3 100	**PK30×37×15.9X**	0.0280
	38	13.8	21 400	26 900	2 180	2 750	**PK30×38×13.8X1**	0.0294
	38	15.8	24 600	32 000	2 510	3 300	**PK30×38×15.8X**	0.0320
	38	17.8	27 700	37 500	2 820	3 800	**PK30×38×17.8X1**	0.037
31	41	21.4	34 000	43 000	3 500	4 350	**PK31×41×21.4X**	0.057
32	43	22.4	40 000	49 500	4 100	5 050	**PK32×43×22.4X**	0.069
34	42	19.8	31 500	45 500	3 200	4 650	**PK34×42×19.8X**	0.046
38	47	19.8	35 500	51 000	3 600	5 200	**PK38×47×19.8X1**	0.056

For piston-pin

Type KBK



F_w 7～22mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Bearing numbers	Mass kg
F_w	E_w	B_c $^{0}_{-0.2}$	L_w	C_r	C_{or}	C_r	C_{or}		(approx.)
7	10	9.8	6.8	3 050	2 780	310	284	**KBK 7×10× 9.8X**	0.0022
8	11	11.8	8.8	4 100	4 200	415	430	**KBK 8×11×11.8X1**	0.0028
9	12	11.5	8.8	4 400	4 750	450	485	**KBK9×12×11.7V2**	0.0030
	14	9.8	6.8	4 500	4 200	460	430	**KBK10×14× 9.8X**	0.0042
10	14	12.5	9.8	6 100	6 200	620	635	**KBK10×14×12.5X1**	0.0053
	14	14.8	9.8	6 100	6 200	620	635	**KBK10×14×14.8X**	0.0064
	14	13.5	10.8	5 850	7 250	595	740	**KBK11×14×13.5X1**	0.0044
11	15	12.3	9.8	7 050	7 700	720	785	**KBK11×15×12.3X5**	0.0049
	15	15.8	11.8	7 050	7 650	720	780	**KBK11×15×15.8X2**	0.0069
	15	16.4	13.8	7 500	10200	765	1040	**KBK12×15×16.6V1**	0.0056
	16	14.8	11.8	7 600	8 600	775	875	**KBK12×16×14.8X1**	0.0062
12	16	15.4	9.8	7 000	7 800	715	795	**KBK12×16×15.6**	0.0079
	16	15.8	12.8	8 100	9 350	825	955	**KBK12×16×16**	0.0073
	17	14.8	9.8	8 400	8 550	855	875	**KBK12×17×14.8X**	0.0094
	18	16.8	13.8	9 750	12 400	995	1 260	**KBK14×18×17**	0.0089
14	18	19.8	13.8	9 150	11 300	930	1 160	**KBK14×18×20**	0.0130
	19	17.1	12.8	11 100	12 700	1 130	1 300	**KBK14×19×17.1X**	0.0120
15	19	17.3	13.8	10 900	14 600	1 110	1 490	**KBK15×19×17.3X**	0.0100
	20	16.8	13.8	10 800	14 700	1 100	1 500	**KBK16×20×17**	0.0100
16	20	19.6	13.8	10 200	13 600	1 040	1 390	**KBK16×20×19.8**	0.0130
	20	23.8	19.8	13 600	19 700	1 390	2 010	**KBK16×20×23.8X**	0.0150
	21	19.6	15.8	13 900	17 600	1 420	1 790	**KBK16×21×19.6X**	0.0160
	21	23	15.8	13 200	19 400	1 340	1 980	**KBK17×21×23.2**	0.0160
17	21	25	17.8	13 100	19 200	1 340	1 960	**KBK17×21×25X**	0.0170
	22	22	18.8	16 900	22 900	1 720	2 340	**KBK17×22×22X1**	0.0170
18	22	21.8	15.8	12 500	18 300	1 270	1 870	**KBK18×22×21.8X3**	0.0150
	22	23.8	17.8	13 000	19 300	1 330	1 970	**KBK18×22×23.8X1**	0.0160
20	25	27.9	21.8	20 800	31 500	2 120	3 200	**KBK20×25×27.9X**	0.0270
22	28	29.9	23.8	26 000	38 000	2 650	3 900	**KBK22×28×29.9X4**	0.038