12.8 CYLINDRICAL ROLLER THRUST BEARINGS

Design

Cylindrical roller thrust bearings are design for solid and sustainable loadings and resistant to shock stressing. They are standardly offered as single direction bearings that can transfer axial loads only in one direction.

Bearings have a simple shape and can have a single row (fig. 12.8.1) or double row (fig. 12.8.2) design. They are used primarily in heavy-duty loadings, in which thrust ball bearings sometimes fail.

Cylindrical rollers with a modified surface that ensure optimal rolling without edge stressing are installed in the bearings.

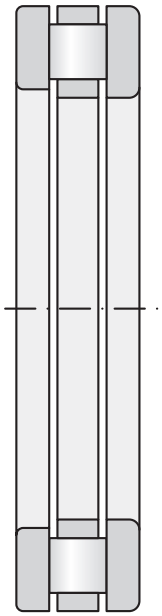


Fig. 12.8.1

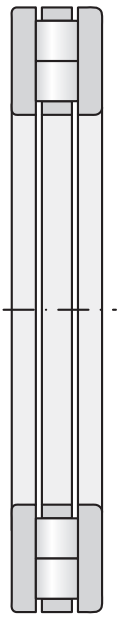


Fig. 12.8.2

Components

Bearing components allow for numerous combinations of bearing designs, where e.g. only a cage with rollers is used and the raceways form individual machine parts (fig. 12.8.3) or a combined loading may be sued, when the machine part comprises one raceway and the bearing ring the second part. An independent cage with rollers has the additional marking K, an independent shaft ring WS, and an independent housing ring GS.

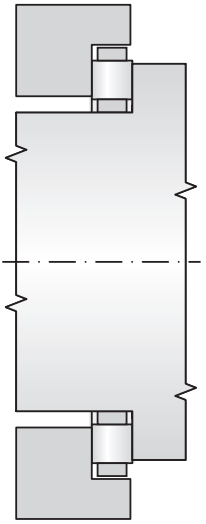


Fig. 12.8.3

Double direction bearings

Bearings can be assembled from housing rings or shaft rings with two cages with rollers and a corresponding centre ring, which is centred on the inner diameter (fig. 12.8.4) or outer (fig. 12.8.5) diameter. The centre ring must be made in the same quality as the respective bearing rings. We recommend consulting ZKL Technical and Consultation Services for more information.

Basic information

Dimensions

Main dimensions of thrust ball bearings conform to ISO 104.

Tolerances

Standard manufacturing of bearings is provided at a normal degree of precision, which is not labelled. Bearings may also be supplied at higher precision P5. Bearing dimension tolerances meet standard ISO 199. These values are provided in tables 7.16a and 7.16b.

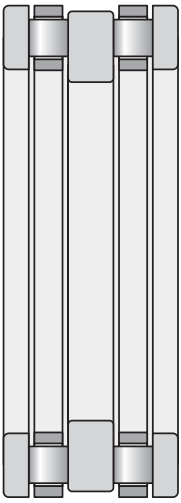


Fig. 12.8.4

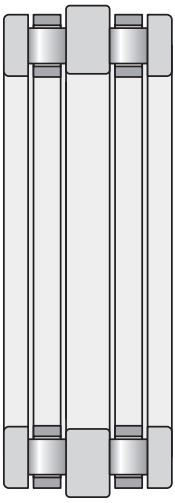


Fig. 12.8.5

Shaft and housing rings and rollers with a cage are manufactured to tolerances specified in tables 12.8.1. and 12.8.2. Rollers in a single cage are from one sorting group and their diameter variance is 1 μm.

Table 12.8.1

Bearing component tolerances		
Bearing components Dimensions		**Tolerances**
Cage with rollers, K		
Bore diameter	d	E11
Outer diameter	D	a13
Roller diameter	Dw	DIN 5402-1:1993
Shaft ring, WS		
Bore diameter	d	Normal tolerance
Outer diameter	d1	-
Thickness	B	h11
Axial runout	Si	Normal tolerance
Tělesový kroužek, GS		
Outer diameter	D	Normal tolerance
Bore diameter	D1	-
Thickness	B	h11
Axial runout	Se	Normal tolerance

Table 12.8.2

ISO Tolerances							
Nominal diameter d, D		Tolerance a13		Tolerance h11		Tolerance E11	
over	including	max	min	max	min	max	min
mm		μm					
10	18	-290	-560	0	-110	+142	+32
18	30	-300	-630	0	-130	+170	+40
30	40	-310	-700	0	-160	+210	+50
40	50	-320	-710	0	-160	+210	+50
50	65	-340	-800	0	-190	+250	+60
65	80	-360	-820	0	-190	+250	+60
80	100	-380	-920	0	-220	+292	+72
100	120	-410	-950	0	-220	+292	+72
120	140	-460	-1090	0	-250	+335	+85
140	160	-520	-1150	0	-250	+335	+85
160	180	-580	-1210	0	-250	+335	+85
180	200	-660	-1380	0	-290	+390	+100
200	225	-740	-1460	0	-290	+390	+100
225	250	-820	+1540	0	-290	+390	+100
250	280	-920	-1730	0	-320	+430	+110
280	315	-1050	-1860	0	-320	+430	+110
315	355	-1200	-2090	0	-360	+485	+125
355	400	-1350	-2240	0	-360	+485	+125
400	450	-1500	-2470	0	-400	+535	+135
450	500	-1650	-2620	0	-400	+535	+135
500	630	-1900	-3000	0	-440	+585	+145
630	800	-2100	-3350	0	-500	+660	+150

Misalignment

Misalignment between the shaft and the housing is not permitted. Spherical roller thrust bearings do not allow for compensation of such misalignment.

Cages

Thrust ball bearings are equipped with a massive brass cage, additional markings M, MB.

Minimal axial load

A certain minimal load, which ensures reliable operation, must act on thrust ball bearings. Failure to adhere to this load could lead to non-standard rolling off, slippage, and subsequent damage of ring raceways and roller elements.

The minimal requisite load is determined from the equation:

$$F_{a\,min} = \left(\frac{C_{oa}}{2000} \right) + M \cdot \left(\frac{n}{1000} \right)^2$$

$F_{a\,min}$ .... minimal load (kN)

C_o ..... static bearing capacity (kN)

M ..... coefficient of minimum axial load (see tables)

n ..... revolutions (min^{-1})

A higher minimal load is required when starting the bearing under low temperatures or when using a high viscosity lubricant. If the minimal load is not derived naturally in the arrangement of the bearing structure, then the bearing must be loaded with an auxiliary force by springs or by the shaft nut.

Bearing equivalent dynamic load capacity

$$P = F_a$$

Bearing equivalent static load capacity

$$P_o = F_a$$

Additional markings

Additional markings after the basic markings express a particular bearing characteristic:

K ..... cage with rollers

WS..... shaft ring

GS ..... housing ring

M..... massive brass cage guided on rollers

MB..... massive brass shaft-guided cage

Structure of related components

Perfect resting of rings must be ensured in the developed hub along its entire perimeter and across its breadth. The support surfaces in the hub and on the shaft must be perpendicular to the axis of the shaft. Required dimensional tolerances of loadings for bearings on a shaft and in the hub are listed in table 12.8.3.

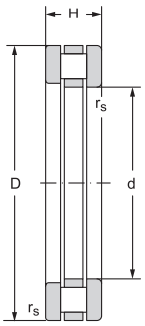
Higher speeds necessitate the selection of cage guiding on a shaft, and the shaft guiding surfaces must thus be polished.

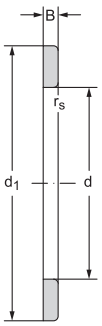
Raceways on the shaft and in the hub

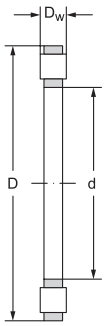
Orbits on the shaft and in the hub should have the same hardness and surface quality as bearing raceways. Failure to meet the specified parameters will result in failure to achieve the bearing load capacity parameters.

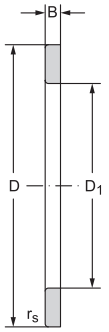
Table 12.8.3

Shaft and hub bore tolerances			
Bearing component	Tolerance		
Name	Prefix	Shaft	Hub bore
Cage with rollers	K	h8	-
Shaft ring	WS	h8	-
Hub ring	GS	-	H9



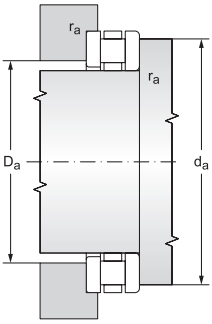


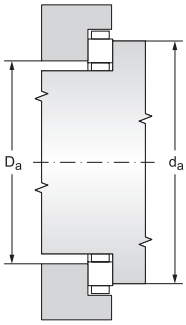




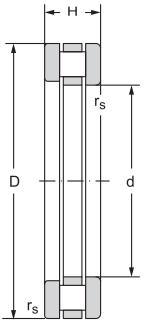
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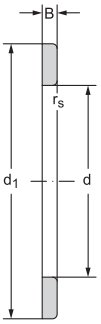
Main dimensions								Basic load rating		Fatique load limit
								dynamic	static	
d	D	H	d_1	D_1	B	D_w	r_s	C_a	C_{oa}	P_u
							min			
mm								kN		kN
15	28	9,0	28,0	16,0	2,75	3,5	0,3	9,3	26,8	3,27
17	30	9,0	30,0	18,0	2,75	3,5	0,3	11,5	30	3,66
20	35	10,0	35,0	21,0	2,75	4,5	0,3	16,9	45	5,47
25	42	11,0	42,0	26,0	3,00	5,0	0,6	23,8	66,5	8,11
30	47	11,0	47,0	32,0	3,00	5,0	0,6	26,1	75,5	9,21
	52	16,0	52,0	32,0	4,25	7,5	0,6	48,9	131	16,00
35	52	12,0	52,0	37,0	3,50	5,0	0,6	27,8	90,5	11,00
	62	18,0	62,0	37,0	5,25	7,5	1,0	60,1	184	22,40
40	60	13,0	60,0	42,0	3,50	6,0	0,6	41,2	135	16,50
	68	19,0	68,0	42,0	5,00	9,0	1,0	82	147	17,90
45	65	14,0	65,0	47,0	4,00	6,0	0,6	43,2	149	18,20
	73	20,0	73,0	47,0	5,50	9,0	1,0	81,3	250	30,50
50	70	14,0	70,0	52,0	4,00	6,0	0,6	44,9	160	19,50
	78	22,0	78,0	52,0	6,50	9,0	1,0	90,1	296	36,10
55	78	16,0	78,0	57,0	5,00	6,0	0,6	66,9	281	34,30
	90	25,0	90,0	57,0	7,00	11,0	1,0	120	379	46,20
60	85	17,0	85,0	62,0	4,75	7,5	1,0	77,9	294	35,90
	95	26,0	95,0	62,0	7,50	11,0	1,0	134	458	55,90
65	90	18,0	90,0	67,0	5,25	7,5	1,0	81,7	314	38,30
	100	27,0	100,0	67,0	8,00	11,0	1,0	137	481	58,70
70	95	18,0	95,0	72,0	5,25	7,5	1,0	84,7	340	41,50
	105	27,0	105,0	72,0	8,00	11,0	1,0	144	519	63,30
75	100	19,0	100,0	77,0	5,75	7,5	1,0	82	331	40,40
	110	27,0	110,0	77,0	8,00	11,0	1,0	134	482	58,80
80	105	19,0	105,0	82,0	5,75	7,5	1,0	79,1	328	40,00
	115	28,0	115,0	82,0	8,50	11,0	1,0	149	602	73,40

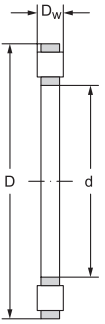


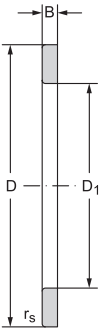


Limiting speed for lubrication with		Bearing designation	Abutment and fillet dimensions				Weight	Bearing component designation			Min. axial load factor
grease	oil		d	d_a	D_a	r_a	~	Cage with rollers	Shaft ring	Housing ring	M
				min	max	max					
min^{-1}				mm			kg				
3200	4300	**81102**	15	27	16	0,3	0,023	**K 81102**	**WS 81102**	**GS 81102**	0,00006
3200	4300	**81103**	17	29	18	0,3	0,027	**K 81103**	**WS 81103**	**GS 81103**	0,00008
2800	3800	**81104**	20	34	21	0,3	0,037	**K 81104**	**WS 81104**	**GS 81104**	0,00019
2200	3200	**81105**	25	41	26	0,6	0,053	**K 81105**	**WS 81105**	**GS 81105**	0,0004
2000	3000	**81106**	30	46	31	0,6	0,057	**K 81106**	**WS 81106**	**GS 81106**	0,0005
1700	2400	**81206**	30	50	31	0,6	0,12	**K 81206**	**WS 81206**	**GS 81206**	0,0014
1900	2800	**81107**	35	51	36	0,6	0,073	**K 81107**	**WS 81107**	**GS 81107**	0,0007
1500	2000	**81207**	35	58	39	1,0	0,20	**K 81207**	**WS 81207**	**GS 81207**	0,003
1700	2400	**81108**	40	58	42	0,6	0,11	**K 81108**	**WS 81108**	**GS 81108**	0,0016
1400	1900	**81208**	40	66	43	1,0	0,25	**K 81208**	**WS 81208**	**GS 81208**	0,0053
1600	2200	**81109**	45	63	47	0,6	0,13	**K 81109**	**WS 81109**	**GS 81109**	0,002
1300	1800	**81209**	45	70	48	1,0	0,29	**K 81209**	**WS 81209**	**GS 81209**	0,0059
1600	2100	**81110**	50	68	52	0,6	0,14	**K 81110**	**WS 81110**	**GS 81110**	0,0023
1200	1700	**81210**	50	75	53	1,0	0,36	**K 81210**	**WS 81210**	**GS 81210**	0,0072
1400	1900	**81111**	55	77	56	0,6	0,22	**K 81111**	**WS 81111**	**GS 81111**	0,0068
950	1400	**81211**	55	85	59	1,0	0,57	**K 81211**	**WS 81211**	**GS 81211**	0,013
1200	1800	**81112**	60	82	62	1,0	0,28	**K 81112**	**WS 81112**	**GS 81112**	0,0075
900	1350	**81212**	60	91	64	1,0	0,65	**K 81212**	**WS 81212**	**GS 81212**	0,018
1200	1700	**81113**	65	87	67	1,0	0,31	**K 81113**	**WS 81113**	**GS 81113**	0,0083
900	1300	**81213**	65	96	69	1,0	0,73	**K 81213**	**WS 81213**	**GS 81213**	0,020
1150	1650	**81114**	70	92	72	1,0	0,34	**K 81114**	**WS 81114**	**GS 81114**	0,0098
870	1250	**81214**	70	102	74	1,0	0,78	**K 81214**	**WS 81214**	**GS 81214**	0,023
1100	1600	**81115**	75	97	78	1,0	0,40	**K 81115**	**WS 81115**	**GS 81115**	0,0068
850	1200	**81215**	75	106	79	1,0	0,80	**K 81215**	**WS 81215**	**GS 81215**	0,015
1000	1500	**81116**	80	102	83	1,0	0,41	**K 81116**	**WS 81116**	**GS 81116**	0,0074
830	1150	**81216**	80	112	84	1,0	0,92	**K 81216**	**WS 81216**	**GS 81216**	0,029



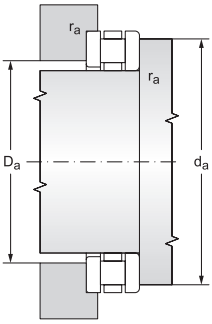


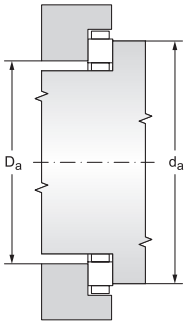




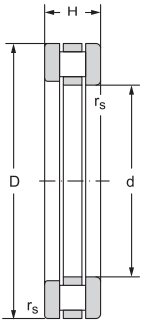
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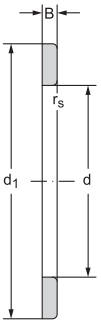
Main dimensions								Basic load rating		Fatique load limit
								dynamic	static	
d	D	H	d_1	D_1	B	D_w	r_s	C_a	C_{oa}	P_u
							min			
mm								kN		kN
85	110	19,0	110,0	87,0	5,75	7,5	1,0	86	360	44,00
	125	31,0	125,0	88,0	9,50	12,0	1,0	166	624	76,00
90	120	22,0	120,0	92,0	6,50	9,0	1,0	102	444	53,40
	135	35,0	135,0	93,0	10,50	14,0	1,1	231	860	101,00
100	135	25,0	135,0	102,0	7,00	11,0	1,0	152	605	70,30
	150	38,0	150,0	103,0	11,50	15,0	1,1	255	1010	115,00
110	145	25,0	145,0	112,0	7,0	11,0	1,0	160	670	76,00
	160	38,0	160,0	113,0	11,5	15,0	1,1	255	988	110,00
120	155	25,0	155,0	122,0	7,0	11,0	1,0	167	729	80,80
	170	39,0	170,0	123,0	12,0	15,0	1,1	260	1020	111,00
130	170	30,0	170,0	132,0	9,0	12,0	1,0	189	865	93,40
	190	45,0	187,0	133,0	13,0	19,0	1,5	371	1390	147,00
140	180	31,0	178,0	142,0	9,5	12,0	1,0	201	920	97,40
	200	46,0	197,0	143,0	13,5	19,0	1,5	349	1300	135,00
150	190	31,0	188,0	152,0	9,5	12,0	1,0	210	980	102,00
	215	50,0	212,0	153,0	14,5	21,0	1,5	457	1840	187,00
160	200	31,0	198,0	162,0	9,5	12,0	1,0	202	980	100,00
	225	51,0	222,0	163,0	15,0	21,0	1,5	477	1900	190,00
170	215	34,0	213,0	172,0	10,0	14,0	1,1	282	1330	133,00
	240	55,0	237,0	173,0	16,5	22,0	1,5	529	2190	215,00
180	225	34,0	222,0	183,0	10,0	14,0	1,1	264	1210	119,00
	250	56,0	247,0	183,0	17,0	22,0	1,5	549	2390	232,00
190	240	37,0	237,0	193,0	11,0	15,0	1,1	302	1360	132,00
	270	62,0	267,0	194,0	18,0	26,0	2,0	691	2880	274,00
200	250	37,0	247,0	203,0	11,0	15,0	1,1	303	1470	141,00
	280	62,0	277,0	204,0	18,0	26,0	2,0	711	3050	286,00
220	270	37,0	267,0	223,0	11,0	15,0	1,1	329	1670	156,00
	300	62,0	297,0	224,0	18,5	26,0	2,0	738	3230	296,00

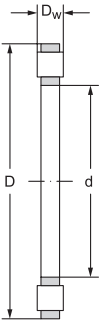


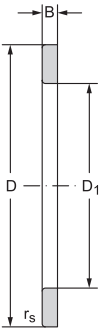


Limiting speed for lubrication with		Bearing designation	Abutment and fillet dimensions				Weight	Bearing component designation			Min. axial load factor
grease	oil		d	d_a	D_a	r_a	~	Cage with rollers	Shaft ring	Housing ring	M
				min	max	max					
min^{-1}				mm			kg				
950	1500	**81117**	85	108	87	1,0	0,42	**K 81117**	**WS 81117**	**GS 81117**	0,012
800	1100	**81217**	85	119	90	1,0	1,26	**K 81217**	**WS 81217**	**GS 81217**	0,025
900	1300	**81118**	90	117	93	1,0	0,63	**K 81118**	**WS 81118**	**GS 81118**	0,014
750	1000	**81218**	90	129	95	1,0	1,75	**K 81218**	**WS 81218**	**GS 81218**	0,061
850	1200	**81120**	100	131	104	1,0	0,94	**K 81120**	**WS 81120**	**GS 81120**	0,028
670	900	**81220**	100	142	107	1,0	2,15	**K 81220**	**WS 81220**	**GS 81220**	0,056
800	1100	**81122M**	110	141	114	1,0	1,04	**K 81122M**	**WS 81122**	**GS 81122**	0,031
630	850	**81222M**	110	152	117	1,0	2,28	**K 81222M**	**WS 81222**	**GS 81222**	0,068
750	1050	**81124M**	120	151	124	1,0	1,10	**K 81124M**	**WS 81124**	**GS 81124**	0,038
530	800	**81224M**	120	162	127	1,0	2,55	**K 81224M**	**WS 81224**	**GS 81224**	0,076
700	950	**81126M**	130	165	135	1,0	2,72	**K 81126M**	**WS 81126**	**GS 81126**	0,049
530	700	**81226M**	130	181	137	1,5	4,30	**K 81226M**	**WS 81226**	**GS 81226**	0,170
670	900	**81128M**	140	175	145	1,0	2,05	**K 81128M**	**WS 81128**	**GS 81128**	0,059
530	650	**81228M**	140	191	147	1,5	4,61	**K 81228M**	**WS 81228**	**GS 81228**	0,162
530	850	**81130M**	150	185	155	1,0	2,10	**K 81130M**	**WS 81130**	**GS 81130**	0,067
480	630	**81230M**	150	211	158	1,5	6,04	**K 81230M**	**WS 81230**	**GS 81230**	0,300
630	830	**81132M**	160	195	165	1,0	2,23	**K 81132M**	**WS 81132**	**GS 81132**	0,085
450	600	**81232M**	160	220	168	1,5	6,27	**K 81232M**	**WS 81232**	**GS 81232**	0,330
600	800	**81134M**	170	209	176	1,0	2,98	**K 81134M**	**WS 81134**	**GS 81134**	0,110
430	560	**81234M**	170	235	180	1,5	7,80	**K 81234M**	**WS 81234**	**GS 81234**	0,430
560	750	**81136M**	180	219	185	1,0	3,10	**K 81136M**	**WS 81136**	**GS 81136**	0,130
410	540	**81236M**	180	245	190	1,5	8,35	**K 81236M**	**WS 81236**	**GS 81236**	0,470
530	700	**81138M**	190	233	197	1,0	3,90	**K 81138M**	**WS 81138**	**GS 81138**	0,170
380	500	**81238M**	190	265	200	2,0	10,6	**K 81238M**	**WS 81238**	**GS 81238**	0,680
510	680	**81140M**	200	243	206	1,0	4,10	**K 81140M**	**WS 81140**	**GS 81140**	0,190
370	490	**81240M**	200	275	210	2,0	12,2	**K 81240M**	**WS 81240**	**GS 81240**	0,790
500	670	**81144M**	220	263	226	1,0	4,60	**K 81144M**	**WS 81144**	**GS 81144**	0,240
360	480	**81244M**	220	296	230	2,0	13,4	**K 81244M**	**WS 81244**	**GS 81244**	0,910



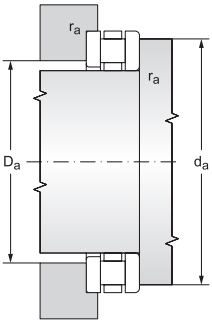


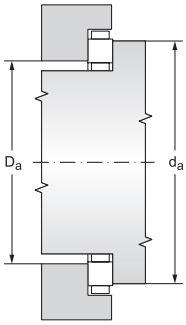




12.8.1

Main dimensions								Basic load rating		Fatique load limit
								dynamic	static	
d	D	H	d_1	D_1	B	D_w	r_s	C_a	C_{oa}	P_u
							min			
mm								kN		kN
240	300	45,0	297,0	243,0	13,5	18,0	1,5	368	2400	217,00
	340	78,0	335,0	244,0	23,0	32,0	2,1	1070	4850	430,00
260	320	45,0	317,0	263,0	13,5	18,0	1,5	488	2650	235,00
	360	79,0	355,0	264,0	23,5	32,0	2,1	1090	5200	452,00
280	350	53,0	347,0	283,0	15,5	22,0	1,5	672	3440	297,00
	380	80,0	375,0	284,0	24,0	32,0	2,0	1150	5510	470,00
300	380	62,0	376,0	304,0	18,5	25,0	2,0	851	4400	372,00
	420	95,0	415,0	304,0	28,5	38,0	3,0	1520	7210	599,00
320	400	63,0	396,0	324,0	19,0	25,0	2,0	878	4590	381,00
	420	95,0	435,0	325,0	28,5	38,0	3,0	1550	7480	616,00
340	420	64,0	416,0	344,0	19,5	25,0	2,0	871	4730	386,00
	460	96,0	455,0	345,0	29,0	38,0	3,0	1580	7890	635,00
360	440	65,0	436,0	364,0	20,0	25,0	2,0	885	4830	389,00
	500	110,0	495,0	365,0	32,5	45,0	4,0	2050	9900	779,00
380	460	65,0	456,0	384,0	20,0	25,0	2,0	915	5100	404,00
400	480	65,0	476,0	404,0	20,0	25,0	2,0	950	5370	420,00
420	500	65,0	495,0	424,0	20,0	25,0	2,0	985	5630	434,00
440	540	80,0	535,0	444,0	24,0	32,0	2,1	1370	7810	591,00
460	560	80,0	555,0	464,0	24,0	32,0	2,1	1400	8020	600,00
480	580	80,0	575,0	484,0	24,0	32,0	2,1	1460	8460	626,00
500	600	80,0	595,0	505,0	24,0	32,0	2,1	1490	8670	634,00
530	640	85,0	635,0	535,0	25,5	34,0	3,0	1670	10000	718,00
560	670	85,0	665,0	565,0	25,5	34,0	3,0	1760	10600	750,00
600	710	85,0	705,0	605,0	25,5	34,0	3,0	1850	11300	784,00
630	750	85,0	746,0	634,0	25,5	38,0	3,0	2160	13200	902,00





Limiting speed for lubrication with		Bearing designation	Abutment and fillet dimensions				Weight	Bearing component designation			Min. axial load factor
grease	oil		d	d_a	D_a	r_a	~	Cage with rollers	Shaft ring	Housing ring	M
				min	max	max					
min^{-1}				mm			kg				
430	560	**81148M**	240	296	248	1,5	7,35	**K 81148M**	**WS 81148**	**GS 81148**	0,500
300	400	**81248M**	240	335	261	2,0	22,1	**K 81248M**	**WS 81248**	**GS 81248**	1,900
400	530	**81152M**	260	316	268	1,5	7,90	**K 81152M**	**WS 81152**	**GS 81152**	0,560
280	380	**81252M**	260	353	280	2,0	24,1	**K 81252M**	**WS 81252**	**GS 81252**	2,300
360	480	**81156M**	280	346	288	1,5	10,5	**K 81156M**	**WS 81156**	**GS 81156**	1,100
260	360	**81256M**	280	373	300	2,0	26,1	**K 81256M**	**WS 81256**	**GS 81256**	2,400
320	430	**81160M**	300	373	315	2,0	16,4	**K 81160M**	**WS 81160**	**GS 81160**	1,500
220	320	**81260M**	300	413	328	2,5	40,3	**K 81260M**	**WS 81260**	**GS 81260**	4,200
300	400	**81164M**	320	394	334	2,0	18,0	**K 81164M**	**WS 81164**	**GS 81164**	1,900
200	300	**81264M**	320	434	348	2,5	42,6	**K 81264M**	**WS 81264**	**GS 81264**	4,800
280	380	**81168M**	340	414	354	2,0	19,4	**K 81168M**	**WS 81168**	**GS 81168**	2,000
200	280	**81268M**	340	452	367	2,5	46,9	**K 81268M**	**WS 81268**	**GS 81268**	5,300
270	370	**81172M**	360	434	374	2,0	19,4	**K 81172M**	**WS 81172**	**GS 81172**	2,100
180	260	**81272M**	360	492	393	3,0	65,3	**K 81272M**	**WS 81272**	**GS 81272**	8,800
260	360	**81176M**	380	453	393	2,0	23,5	**K 81176M**	**WS 81176**	**GS 81176**	2,20
250	350	**81180M**	400	473	413	2,0	24,3	**K 81180M**	**WS 81180**	**GS 81180**	2,60
240	340	**81184M****	420	493	433	2,0	27,0	**K 81184M**	**WS 81184**	**GS 81184**	2,80
210	310	**81188M****	440	533	459	2,0	41,6	**K 81188M**	**WS 81188**	**GS 81188**	5,30
200	300	**81192M****	460	553	479	2,0	44,0	**K 81192M**	**WS 81192**	**GS 81192**	5,80
190	280	**81196M****	480	583	500	2,0	47,3	**K 81196M**	**WS 81196**	**GS 81196**	6,10
180	270	**811/500M****	500	592	519	2,0	49,8	**K 811/500M**	**WS 811/500**	**GS 811/500**	7,10
180	260	**811/530M****	530	632	554	2,5	59,1	**K 811/530M**	**WS 811/530**	**GS 811/530**	9,20
170	260	**811/560M****	560	662	584	2,5	62,3	**K 811/560M**	**WS 811/560**	**GS 811/560**	9,90
170	240	**811/600M****	600	702	624	2,5	34,1	**K 811/600M**	**WS 811/600**	**GS 811/600**	12,00
160	220	**811/630M****	630	732	650	2,5	82,3	**K 811/630M**	**WS 811/630**	**GS 811/630**	17,00