TL SERIES SPHERICAL ROLLER BEARINGS

TOUGH AND LONG-LIFE PERFORMANCE IN PAPER MACHINES

STAY IN MOTION. STAY IN CONTROL.

AT HIGH SPEEDS. UNDER HIGH LOADS. IN HIGH HEAT.

BEARINGS FOR PAPER MAKING MACHINERY

High speeds. Moisture. Intense heat. The forces at work on the bearings used throughout these massive mechanical marvels are extreme. And the stakes are high.

With throughput as great as thousands of feet per minute - hundreds of tons each day - a single bearing failure can bring the paper that flies across a machine's interdependent rolls to an abrupt halt. At a significant cost.

Reliability is paramount.

For NSK, product development and design is focused squarely on withstanding the manifold operating and environmental stresses of these applications with:

› increasing capacities for high loads and high speeds

› advanced materials for durability, wear resistance and longer life

› lubrication and seal technology for smooth and clean running

Our product solutions are designed to optimize the performance of machinery and equipment, to assure predictable reliability and to deliver total cost-efficiency.

OUTSTANDING DURABILITY. ENGINEERED IN.

NSK's Tough & Long Life - TL - spherical roller bearings are engineered to outlast and outperform conventional bearing solutions in the high-heat conditions of dryer and calender sections of paper making machines, where bearing failures are an all-too-common obstacle to productivity.

With an advanced approach to material and heat treatment technologies, NSK's TL bearings deliver unrivaled stability and reliability with:

- **More than twice the service life of conventional bearings** when operating under contaminated conditions
- **High strength resistance** to hoop stress and inner ring cracking
- **High raceway surface hardness** that promotes a long wear-resistant service life
- **Dramatically fewer bearing failures** for optimized machine uptime with reduced maintenance costs

DESIGN AND OPERATING ADVANTAGES

NSK's TL series spherical roller bearings are ideally designed for paper machine dryer roll applications - and wherever elevated temperatures prevail - optimizing machine uptime and efficiency with superior resistance to inner ring fracture and exceptional dimensional stability at high temperatures.

DESIGN FEATURES

- Optimized, high capacity internal design
- Inner rings manufactured with proprietary TL steel composition and heat-treatment process
- With cylindrical and tapered bore
- With a heavy-duty machined brass cage; pressed steel cages with wear-resistant surface treatment utilized for limited range, or available on request
- Dimensional series 222, 223, 230, 231, 232, 239, 240 and 241 in bore diameters from 40 to 1000 mm
- Radial internal clearances from C-normal through C5
- Superior dimensional stability for operating temperatures as high as 200°C

HIGH-PERFORMANCE FACTORS

ADVANCED MATERIAL TECHNOLOGIES

NSK TL series spherical roller bearings extend bearing life through the utilization of leading-edge bearing material and heat treatment technologies. The outcome is an application-optimized solution that effectively mitigates inner ring fracture caused by rising hoop stress that is equally resilient to the damaging effects of particle or water contaminated lubrication.

A proprietary material composition containing appropriate levels of chrome promotes increased hardness. Coupled with an advanced carbonitriding process, the result is a case-hardened inner ring with considerable advantages:

- **Exceptional ring fracture resistance** from high compressive residual stress after heat treatment
- **Long life wear resistance** due to superior surface hardness values, exceeding conventional through-hardened and carburized materials
- **High dimensional stability** at operating temperatures up to 200°

Problem: premature bearing failure	**Countermeasure:** advanced material composition	**Countermeasure:** heat treatment technology	**Solution:** tough and long-life TL steel
› inner ring fracture occurring due to repetitive hoop stress	› optimized material composition promotes increased hardness	› carbonitriding for high compressive strength	› fracture and wear resistant with high dimensional stability

OPERATING ADVANTAGES

- Higher fracture resistance with inner ring strength to accommodate increasing hoop stress caused by shaft temperature rise
- Longer fatigue life achieved with increased raceway surface hardness, even when foreign debris is present
- Dimensional stability at high temperatures equivalent to, or greater than, traditional stabilizing approaches
- An extensive range of dimension series and sizes - for bore diameters up to 1,000 millimeters

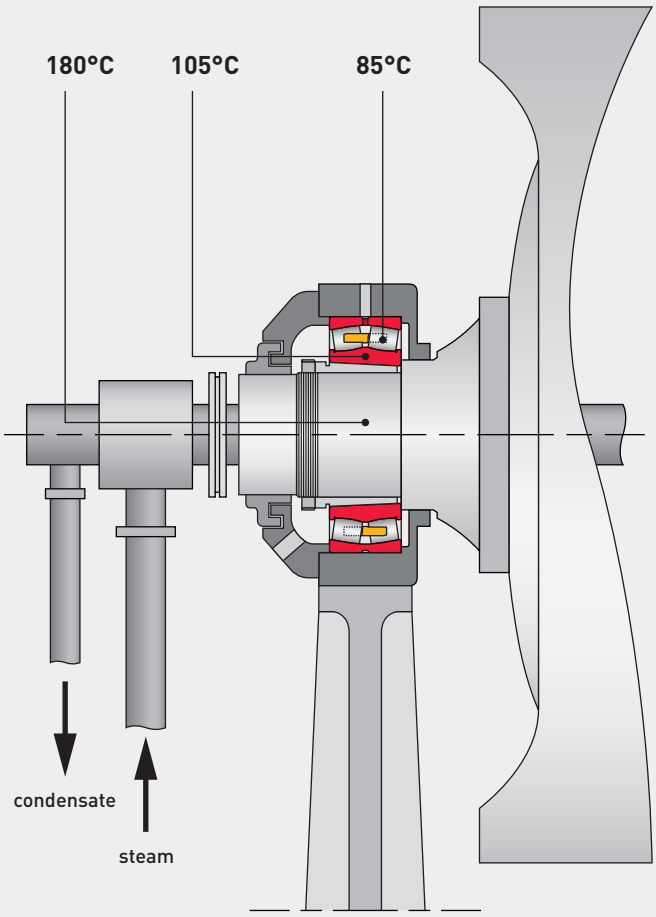
TL STEEL TECHNOLOGY: THE LONG-LIFE SOLUTION

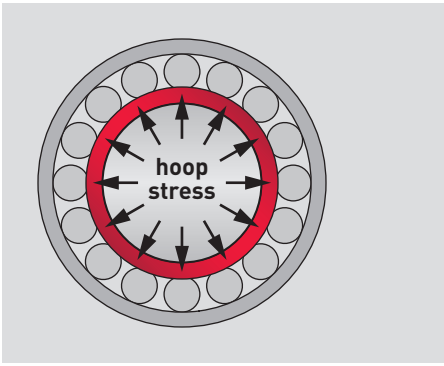
FAILURE MECHANISM IN PAPER MACHINE DRYER ROLLS

On a paper or board machine, the drying process occurs when heat is transferred from the dryer roll to the sheet contacting to the roll. The source of this heat is steam, passing through the hollow axis of the roll. Increasingly higher steam temperatures can contribute to higher drying speed and improved machine efficiency, but not without presenting a significant challenge to the bearings that are essential to smooth and trouble-free operation.

On machine start-up in particular, high steam temperature causes the journal to expand more rapidly than the bearing. This increases the tightness of fit between the mating surfaces and causes hoop stress (circumferential force) to be applied to the bearing inner ring. As this thermal stress increases, so too does the risk of crack formation and the inevitability of inner ring fracture.

Conventional measures such as adopting a slow start-up procedure can prevent such problems — by introducing temperature gradually — but can consume several hours and compromise production. And other approaches to product solutions exist, but with compromised success.





Illustrated at top:
Example of a dryer cylinder roll structure showing the typical temperatures present

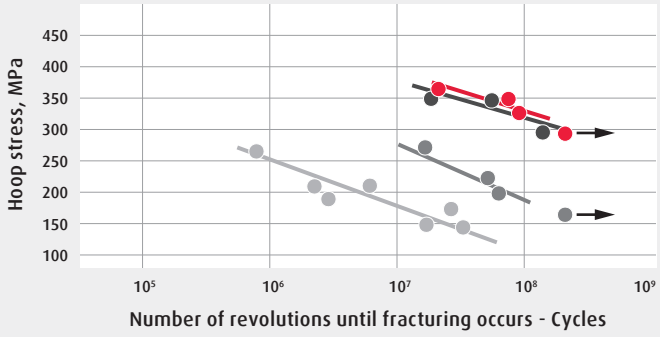
At bottom right:
The journal expands faster than the bearing inner ring, creating an extremely tight shaft fit and causing severe hoop stress

At bottom left:
The inner ring of a damaged spherical roller bearing with axial cracks on the raceway surface

Higher Fracture Resistance

High inner ring strength delivers high resistance to fracture resulting from increasing hoop stress caused by shaft temperature rise.

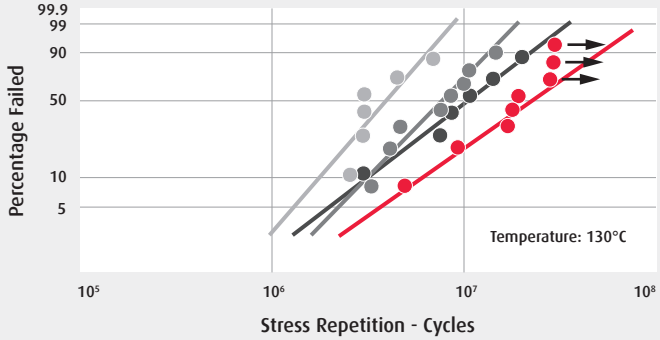
- TL specification steel
- Carburized steel
- Bearing steel with bainite treatment
- Bearing steel with standard heat treatment



Longer Fatigue Life

Increased raceway surface hardness delivers longer life, particularly when foreign debris is present.

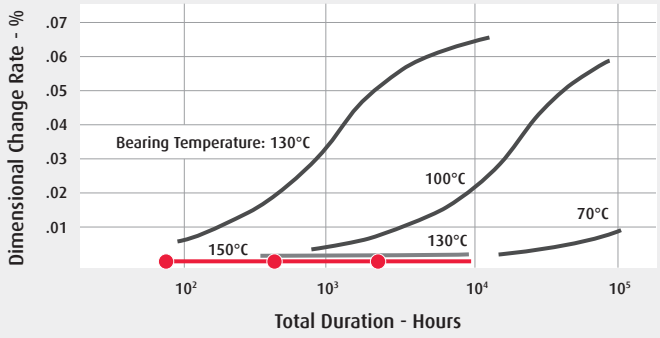
- TL specification steel
- Carburized steel with dimensional stabilizing treatment
- Bearing steel with bainite treatment
- Bearing steel with dimensional stabilizing treatment



Dimensional Stability

Dimensional stability at high temperatures - up to 200°C - is equal to or greater than traditional stabilizing approaches.

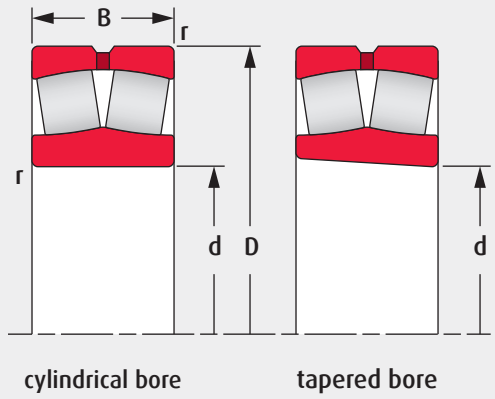
- TL specification steel
- Bearing steel with standard heat treatment
- Bearing steel with dimensional stabilizing treatment

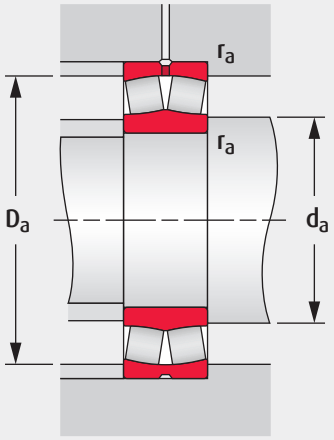


NSK's TL series spherical roller bearings are ideally designed to deliver Tough and Long Life performance wherever elevated temperatures prevail in the paper making process — in dryer rolls, canvas rolls, PV rolls and calender rolls.

When total machine efficiency and output hangs in the balance, NSK TL spherical roller bearings provide an advanced solution with a predictably reliable outcome.

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

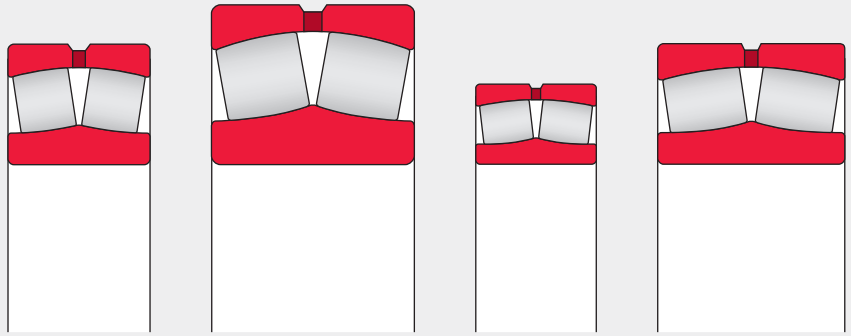
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
40	90	33	1.5	**TL22308CAM(K)E4**	27 500	29 000	5 300	6 700
55	120	43	2.0	**TL22311CAM(K)E4**	47 000	54 000	3 800	4 800
60	130	46	2.1	**TL22312CAM(K)E4**	55 500	64 500	3 600	4 500
65	140	48	2.1	**TL22313EA(K)E4**	84 500	85 500	3 200	4 000
70	150	51	2.1	**TL22314EA(K)E4**	95 500	98 000	3 000	3 800
75	130	31	2.1	**TL22215CAM(K)E4**	76 500	93 500	2 800	3 600
80	170	58	2.1	**TL22316CAM(K)E4**	87 500	108 000	2 600	3 400
90	190	64	3.0	**TL22318EA(K)E4**	149 500	158 500	2 400	3 000
95	200	67	3.0	**TL22319CAM(K)E4**	118 000	151 500	2 200	2 800
100	215	73	3.0	**TL22320EA(K)E4**	193 500	209 000	2 000	2 600
110	170	45	2.0	**TL23022CD(K)E4**	66 000	104 500	2 000	2 400
	200	69.8	2.1	**TL23222C(K)E4**	116 000	171 000	1 500	1 900
	240	80	3.0	**TL22322EA(K)E4**	231 500	252 000	1 700	2 200
120	260	86	3.0	**TL22324EA(K)E4**	267 500	296 500	1 600	2 000
130	280	93	4.0	**TL22326CAM(K)E4**	223 500	303 500	1 300	1 600
140	210	53	2.0	**TL23028CD(K)E4**	94 500	160 500	1 600	1 900
	250	68	3.0	**TL22228CD(K)E4**	145 000	209 000	1 400	1 700
	250	88	3.0	**TL23228C(K)E4**	187 500	292 500	1 100	1 500



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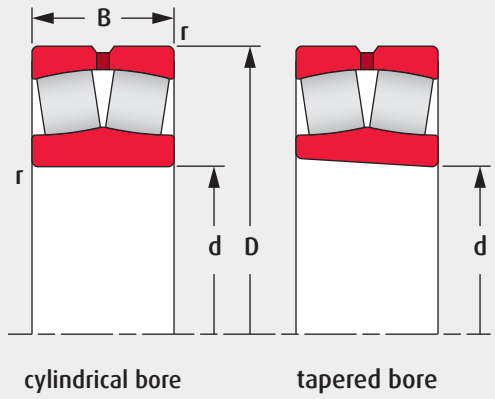
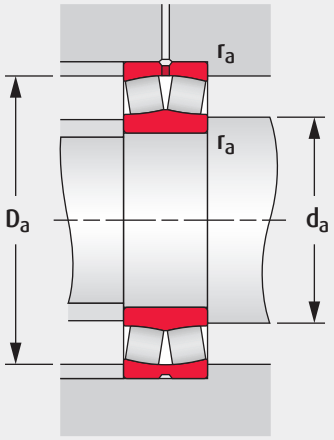
ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
49	-	81	77	1.5	0.38	2.6	1.8	1.7	1.0
65	-	110	103	2.0	0.36	2.8	1.9	1.8	2.3
72	-	118	111	2.0	0.36	2.8	1.9	1.9	2.9
77	84	128	119	2.0	0.33	3.0	2.0	2.0	3.5
82	91	138	129	2.0	0.33	3.0	2.0	2.0	4.3
87	-	148	134	2.0	0.35	2.9	2.0	1.9	3.6
92	-	158	145	2.0	0.35	2.9	2.0	1.9	6.2
104	115	176	163	2.5	0.33	3.1	2.1	2.0	8.6
109	-	186	172	2.5	0.35	2.9	1.9	1.9	9.9
114	130	201	184	2.5	0.33	3.0	2.0	2.0	12.7
120	124	160	153	2.0	0.24	4.2	2.8	2.8	3.8
122	130	188	170	2.0	0.34	3.0	2.0	1.9	9.5
124	145	226	206	2.5	0.30	3.1	2.1	2.0	17.6
134	157	246	222	2.5	0.32	3.1	2.1	2.0	22.2
148	-	262	236	3.0	0.34	2.9	2.0	1.9	27.8
150	157	200	190	2.0	0.22	4.5	3.0	2.9	6.5
154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
154	163	236	213	2.5	0.25	2.9	1.9	1.9	18.8

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

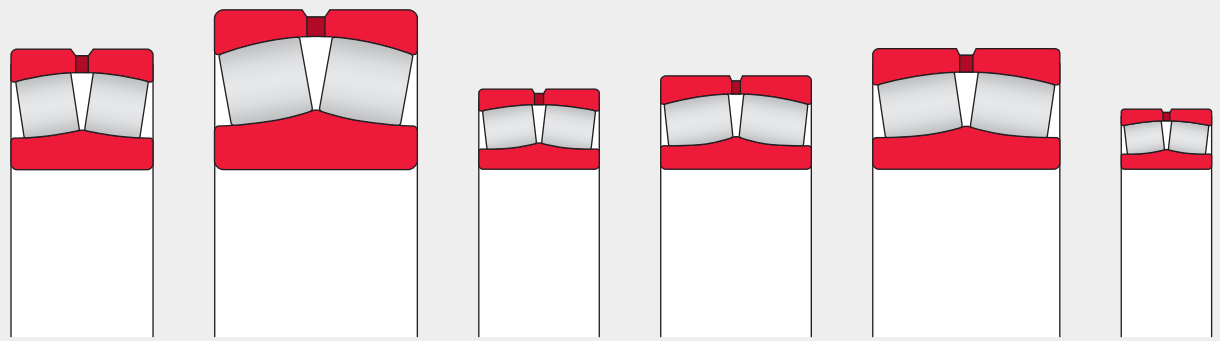
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
150	225	56	2.1	**TL23030CAM(K)E4**	105 500	183 000	1 400	1 800
	250	80	2.1	**TL23130CAM(K)E4**	163 000	265 500	1 100	1 400
	270	73	3.0	**TL22230CD(K)E4**	172 000	252 000	1 300	1 600
	320	108	4.0	**TL22330CAM(K)E4**	274 500	380 000	1 100	1 400
160	240	60	2.1	**TL23032CD(K)E4**	121 500	214 500	1 300	1 700
	290	80	3.0	**TL22232CD(K)E4**	204 500	296 500	1 200	1 500
	290	104	3.0	**TL23232C(K)E4**	247 500	398 000	1 000	1 300
170	230	45	2.0	**TL23934CAM(K)E4**	78 500	148 500	1 400	1 800
	260	67	2.1	**TL23034CD(K)E4**	144 000	245 000	1 200	1 600
	280	88	2.1	**TL23134CAM(K)E4**	211 500	353 000	1 000	1 300
	360	120	4.0	**TL22334CAM(K)E4**	355 000	474 500	1 000	1 200
180	280	74	2.1	**TL23036CD(K)E4**	168 500	285 500	1 200	1 400
	320	112	4.0	**TL23236CAM(K)E4**	292 500	474 500	850	1 100
190	290	75	2.1	**TL23038CAM(K)E4**	174 000	303 500	1 100	1 400
	320	104	3.0	**TL23138CAM(K)E4**	267 500	454 000	850	1 100
	340	92	4.0	**TL22238CAM(K)E4**	256 500	389 000	1 000	1 200
	340	120	4.0	**TL23238CAM(K)E4**	323 500	528 500	800	1 100
	400	132	5.0	**TL22338CAM(K)E4**	425 000	582 500	900	1 100



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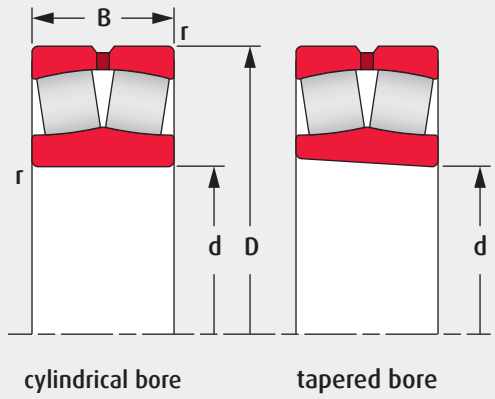
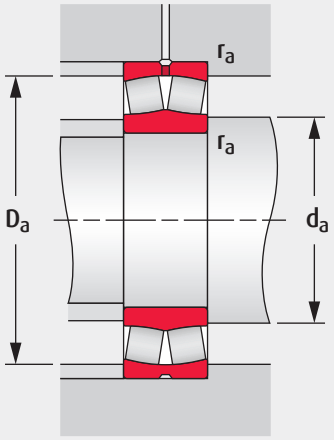
ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
162	-	213	203	2.0	0.22	4.6	3.1	3.0	7.9
162	-	238	218	2.0	0.30	3.4	2.3	2.2	15.8
164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
168	-	302	270	3.0	0.35	2.9	1.9	1.9	41.5
172	179	228	216	2.0	0.22	4.5	3.0	2.9	9.7
174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5
180	-	220	213	2.0	0.17	5.8	3.9	3.8	5.4
182	191	248	233	2.0	0.23	4.3	2.9	2.9	13.0
182	-	268	245	2.0	0.29	3.5	2.3	2.3	21.0
188	-	342	304	3.0	0.35	2.9	1.9	1.9	57.9
192	202	268	249	2.0	0.24	4.2	2.8	2.8	17.1
198	-	302	274	3.0	0.35	2.9	1.9	1.9	38.5
202	-	278	261	2.0	0.24	4.2	2.8	2.8	17.6
204	-	306	276	3.5	0.31	3.2	2.2	2.1	34.0
208	-	322	296	3.0	0.26	3.8	2.6	2.5	35.5
208	-	322	288	3.0	0.35	2.9	1.9	1.9	46.5
212	-	378	338	4.0	0.34	2.9	2.0	1.9	77.6

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

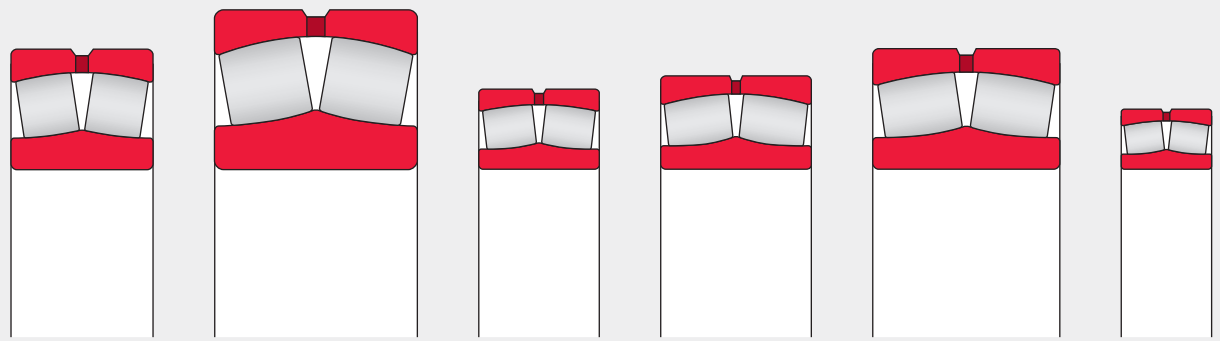
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
200	310	82	2.1	**TL23040CAM(K)E4**	211 500	382 000	1 000	1 300
	340	112	3.0	**TL23140CAM(K)E4**	305 500	524 000	800	2 000
	360	98	4.0	**TL22240CAM(K)E4**	292 500	452 000	950	1 200
	360	128	4.0	**TL23240CAM(K)E4**	373 000	618 000	750	1 000
220	340	90	3.0	**TL23044CAM(K)E4**	245 000	445 000	950	1 200
	370	120	4.0	**TL23144CAM(K)E4**	353 000	609 000	710	950
	400	108	4.0	**TL22244CAM(K)E4**	353 000	546 500	850	1 000
	400	144	4.0	**TL23244CAM(K)E4**	566 500	764 500	670	900
	460	145	5.0	**TL22344CAM(K)E4**	528 500	764 500	750	950
240	320	60	2.1	**TL23948CAM(K)E4**	143 000	292 500	950	1 200
	350	92	3.0	**TL23048CAM(K)E4**	261 000	481 000	850	1 100
	400	128	4.0	**TL23148CAM(K)E4**	402 500	697 000	670	850
	500	155	5.0	**TL22348CAM(K)E4**	584 500	854 500	670	850
250	410	128	4.0	**TLI-112618CAM(K)E4**	400 000	708 000	640	840
260	350	75	2.1	**TL23952CAM(K)E4**	209 000	420 500	850	1 000
	400	104	4.0	**TL23052CAM(K)E4**	321 500	580 000	800	950
	440	144	4.0	**TL23152CAM(K)E4**	485 500	843 000	600	800



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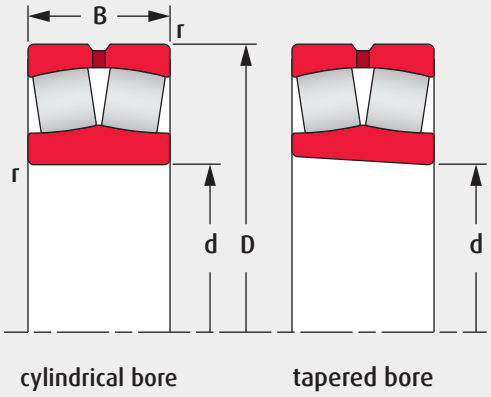
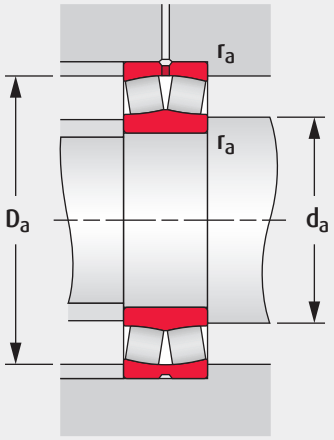
ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
212	-	298	279	2.0	0.25	4.0	2.7	2.6	22.6
214	-	326	293	2.5	0.32	3.2	2.1	2.1	41.5
218	-	342	315	3.0	0.26	3.8	2.6	2.5	42.6
218	-	342	307	3.0	0.35	2.9	1.9	1.9	57.0
234	-	326	302	2.5	0.24	4.1	2.8	2.7	29.7
238	-	352	320	3.0	0.31	3.2	2.2	2.1	52.0
238	-	382	348	3.0	0.27	3.7	2.5	2.4	59.0
238	-	382	337	3.0	0.36	2.8	1.9	1.8	79.5
242	-	438	391	4.0	0.33	3.0	2.0	2.0	116.0
252	-	308	298	2.0	0.17	6.0	4.0	3.9	13.3
254	-	346	324	2.5	0.24	4.2	2.8	2.7	32.6
258	-	382	347	3.0	0.31	3.3	2.2	2.2	64.5
262	-	478	423	4.0	0.32	3.2	2.1	2.1	147.0
268	-	392	357	3.0	0.30	3.4	2.2	2.2	65.2
272	-	348	333	2.0	0.19	5.4	3.6	3.5	23.0
278	-	382	356	3.0	0.25	4.1	2.7	2.7	46.6
278	-	422	380	3.0	0.32	3.2	2.1	2.1	88.2

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

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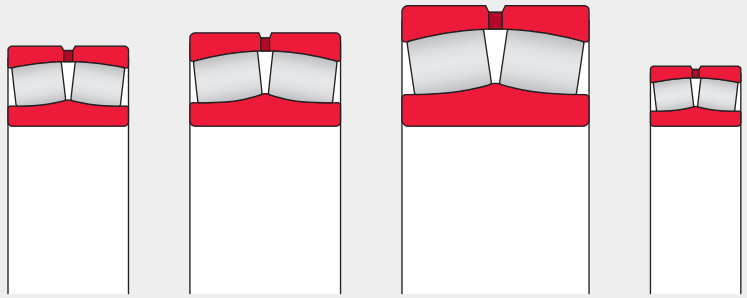
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

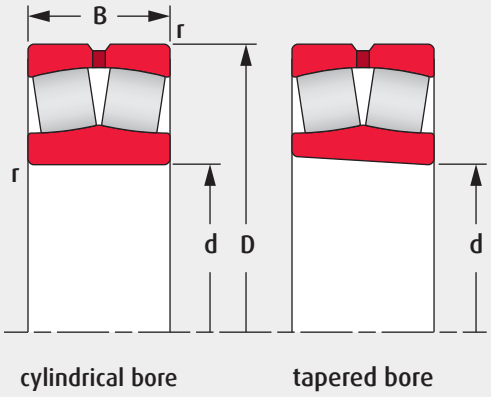
BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
280	380	75	2.1	**TL23956CAM(K)E4**	208 000	438 500	800	950
	420	106	4.0	**TL23056CAM(K)E4**	346 000	663 000	710	900
	460	146	5.0	**TL23156CAM(K)E4**	501 500	899 000	560	750
	500	176	5.0	**TL23256CAM(K)E4**	647 500	1 101 500	530	670
300	420	90	3.0	**TL23960CAM(K)E4**	276 500	560 000	710	900
	460	118	4.0	**TL23060CAM(K)E4**	431 500	832 000	670	850
	500	160	5.0	**TL23160CAM(K)E4**	600 000	1 079 000	500	670
	540	192	5.0	**TL23260CAM(K)E4**	764 500	1 326 500	480	630
320	540	176	5.0	**TL23164CAM(K)E4**	685 500	1 236 500	480	600
340	520	133	5.0	**TL23068CAM(K)E4**	512 500	989 000	560	710
	580	190	5.0	**TL23168CAM(K)E4**	809 500	1 483 500	430	560
360	540	134	4.0	**TL23072CAM(K)E4**	537 500	1 056 500	530	670
380	520	106	4.0	**TL23976CAM(K)E4**	420 500	921 500	530	670
400	600	148	5.0	**TL23080CAM(K)E4**	667 500	1 326 500	480	600
420	560	106	4.0	**TL23984CAM(K)E4**	420 500	955 500	500	600
440	650	157	6.0	**TL23088CAM(K)E4**	708 000	1 427 500	430	530
460	620	118	4.0	**TL23992CAM(K)E4**	499 000	1 113 000	430	530

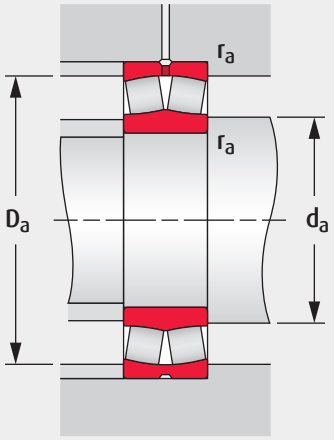


230 231 232 239

ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
292	-	368	351	2.0	0.18	5.7	3.9	3.8	24.5
298	-	402	377	3.0	0.24	4.2	2.8	2.7	50.5
302	-	438	400	4.0	0.30	3.3	2.2	2.2	94.3
302	-	478	425	4.0	0.35	2.9	1.9	1.9	147.0
314	-	406	386	2.5	0.19	5.2	3.5	3.4	38.2
318	-	442	413	3.0	0.24	4.2	2.8	2.7	70.5
322	-	478	433	4.0	0.31	3.3	2.2	2.2	125.0
322	-	518	458	4.0	0.35	2.9	1.9	1.9	189.0
342	-	518	466	4.0	0.31	3.2	2.1	2.1	162.0
362	-	458	465	4.0	0.24	4.2	2.8	2.8	101.0
362	-	558	499	4.0	0.31	3.2	2.1	2.1	206.0
382	-	518	485	4.0	0.24	4.2	2.8	2.8	106.0
398	-	502	482	3.0	0.18	5.5	3.7	3.6	65.4
422	-	578	540	4.0	0.23	4.4	3.0	2.9	146.0
438	-	542	521	3.0	0.17	6.0	4.0	3.9	71.6
468	-	622	587	5.0	0.23	4.3	2.9	2.8	173.0
478	-	602	573	3.0	0.17	5.9	4.0	3.9	100.0

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

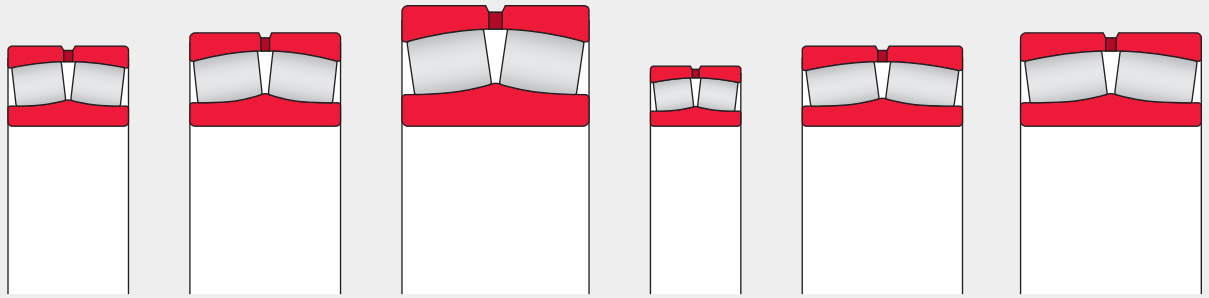
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

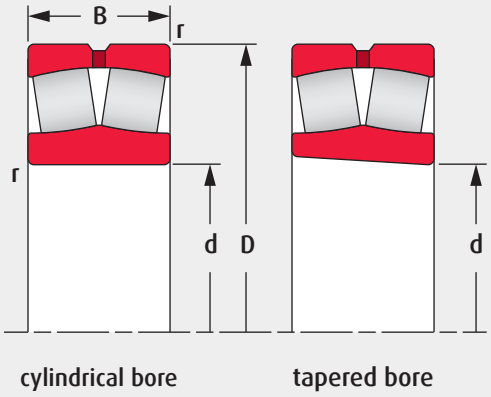
BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
500	670	128	5.0	**TL239/500CAM(K)E4**	553 000	1 247 500	400	500
	720	167	6.0	**TL230/500CAM(K)E4**	843 000	1 821 000	380	480
	720	218	6.0	**TL240/500CAM(K)E4**	1 001 500	2 227 500	300	400
	830	264	7.5	**TL231/500CAM(K)E4**	1 540 000	3 012 500	280	360
	830	325	7.5	**TL241/500CAM(K)E4**	1 800 000	3 600 000	280	360
	920	336	7.5	**TL232/500CAM(K)E4**	2 023 500	3 732 000	260	320
530	710	136	5.0	**TL239/530CAM(K)E4**	658 500	1 528 500	360	450
	780	185	6.0	**TL230/530CAM(K)E4**	989 000	2 068 000	340	430
	780	250	6.0	**TL240/530CAM(K)E4**	1 215 000	2 655 000	280	360
	870	272	7.5	**TL231/530CAM(K)E4**	1 607 500	3 170 000	260	340
	870	335	7.5	**TL241/530CAM(K)E4**	1 912 500	3 937 500	260	340
	980	355	9.5	**TL232/530CAM(K)E4**	2 270 500	4 226 500	240	300
560	750	140	5.0	**TL239/560CAM(K)E4**	697 000	1 630 000	340	430
	820	195	6.0	**TL230/560CAM(K)E4**	1 124 000	2 405 500	320	400
	820	258	6.0	**TL240/560CAM(K)E4**	1 339 000	2 992 500	260	340
	920	280	7.5	**TL231/560CAM(K)E4**	1 765 000	3 484 500	240	320
	920	355	7.5	**TL241/560CAM(K)E4**	2 115 000	4 410 000	240	320
	1030	365	9.5	**TL232/560CAM(K)E4**	2 450 500	4 608 500	220	280

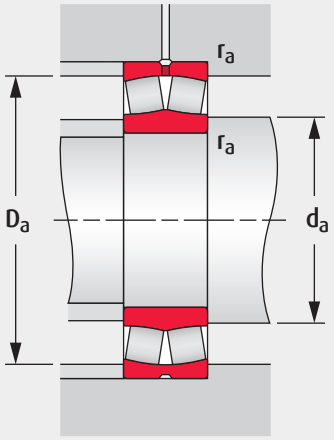


230 231 232 239 240 241

ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
522	-	648	622	4.0	0.17	6.0	4.0	3.9	124.0
528	-	692	655	5.0	0.21	4.8	3.2	3.1	220.0
528	-	692	643	5.0	0.30	3.4	2.3	2.2	276.0
536	-	794	720	6.0	0.31	3.2	2.2	2.1	567.0
536	-	794	703	6.0	0.39	2.6	1.7	1.7	666.0
536	-	884	773	6.0	0.38	2.7	1.8	1.8	969.0
552	-	688	659	4.0	0.17	6.0	4.0	3.9	149.0
558	-	752	706	5.0	0.22	4.6	3.1	3.0	298.0
558	-	752	690	5.0	0.31	3.3	2.2	2.2	390.0
566	-	834	758	6.0	0.30	3.3	2.2	2.2	628.0
566	-	834	740	6.0	0.38	2.6	1.8	1.7	773.0
574	-	936	824	8.0	0.38	2.7	1.8	1.7	1170.0
582	-	728	697	4.0	0.16	6.1	4.1	4.0	172.0
588	-	792	742	5.0	0.22	4.5	3.0	2.9	344.0
588	-	792	729	5.0	0.30	3.3	2.2	2.2	440.0
596	-	884	804	6.0	0.30	3.4	2.3	2.2	727.0
596	-	884	782	6.0	0.39	2.6	1.8	1.7	886.0
604	-	986	870	8.0	0.36	2.8	1.9	1.8	1320.0

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

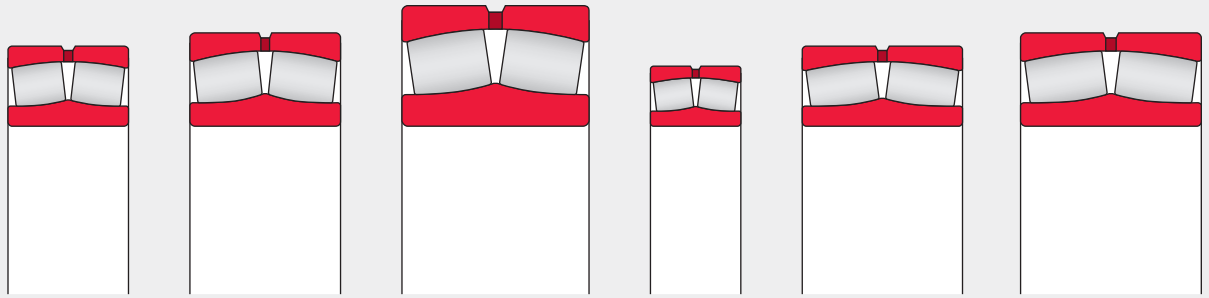
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

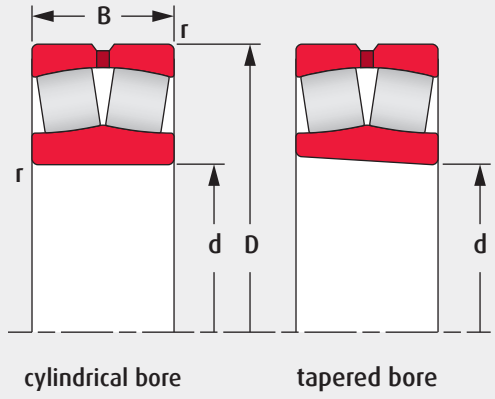
BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
600	800	150	5.0	**TL239/600CAM(K)E4**	775 500	1 821 000	320	400
	870	200	6.0	**TL230/600CAM(K)E4**	1 225 000	2 742 500	300	360
	870	272	6.0	**TL240/600CAM(K)E4**	1 485 000	3 397 500	240	320
	980	300	7.5	**TL231/600CAM(K)E4**	1 967 000	3 934 000	220	280
	980	375	7.5	**TL241/600CAM(K)E4**	2 340 000	4 927 500	220	280
	1090	388	9.5	**TL232/600CAM(K)E4**	2 855 000	5 597 500	200	260
630	850	165	6.0	**TL239/630CAM(K)E4**	899 000	2 102 000	300	360
	920	212	7.5	**TL230/630CAM(K)E4**	1 326 500	2 855 000	280	340
	1030	315	7.5	**TL231/630CAM(K)E4**	2 158 000	4 361 500	200	260
	1030	400	7.5	**TL241/630CAM(K)E4**	2 542 500	5 377 500	200	260
670	900	170	6.0	**TL239/670CAM(K)E4**	979 000	2 317 500	260	340
	980	230	7.5	**TL230/670CAM(K)E4**	1 541 500	3 375 000	240	320
	1090	412	7.5	**TL241/670CAM(K)E4**	2 790 000	5 962 500	190	240

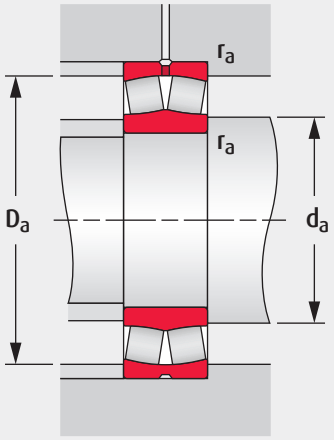


230 231 232 239 240 241

ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
622	-	778	745	4.0	0.17	5.9	3.9	3.9	205.0
628	-	842	794	5.0	0.21	4.8	3.3	3.2	389.0
628	-	842	772	5.0	0.30	3.3	2.2	2.2	529.0
636	-	944	856	6.0	0.30	3.4	2.3	2.2	898.0
636	-	944	836	6.0	0.39	2.6	1.8	1.7	1050.0
644	-	1 046	923	8.0	0.36	2.8	1.9	1.8	1590.0
658	-	822	786	5.0	0.18	5.6	3.8	3.7	259.0
666	-	884	835	6.0	0.22	4.7	3.1	3.1	468.0
666	-	994	900	6.0	0.30	3.4	2.3	2.2	1040.0
666	-	994	876	6.0	0.38	2.7	1.8	1.7	1250.0
698	-	872	836	5.0	0.17	5.8	3.9	3.8	300.0
706	-	944	891	6.0	0.22	4.7	3.1	3.1	571.0
706	-	1 054	934	6.0	0.37	2.7	1.8	1.8	1440.0

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

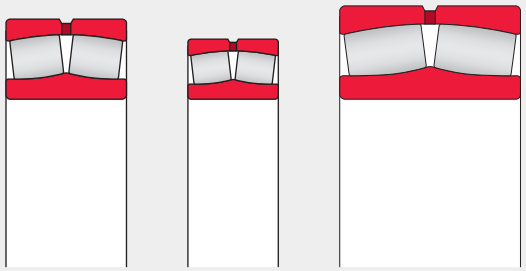
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load:

$P_0 = F_r + Y_0F_a$

The values for e, Y_2, Y_3 and Y_0 are given in the table below.

BOUNDARY DIMENSIONS				BASIC BEARING NO.	BASIC LOAD RATINGS		LIMITING SPEEDS	
mm					kN		rpm	
d	D	B	r (min)		dynamic	static	grease	oil
710	950	180	6.0	**TL239/710CAM(K)E4**	1 080 000	2 632 500	240	300
	1030	236	7.5	**TL230/710CAM(K)E4**	1 597 500	3 555 000	240	280
	1150	438	9.5	**TL241/710CAM(K)E4**	3 127 500	6 862 500	170	220
750	1000	185	6.0	**TL239/750CAM(K)E4**	1 181 500	2 880 000	220	280
	1090	250	7.5	**TL230/750CAM(K)E4**	1 744 000	3 870 000	220	260
800	1060	195	6.0	**TL239/800CAM(K)E4**	1 260 000	3 082 500	220	260
	1150	258	7.5	**TL230/800CAM(K)E4**	1 879 000	4 297 500	200	240
850	1120	200	6.0	**TL239/850CAM(K)E4**	1 372 500	3 420 000	190	240
850	1220	272	7.5	**TL230/850CAM(K)E4**	2 092 500	4 815 000	180	220
950	1250	224	7.5	**TL239/950CAM(K)E4**	1 710 000	4 477 500	160	200
950	1360	300	7.5	**TL230/950CAM(K)E4**	2 542 500	5 962 500	150	190
1000	1320	236	7.5	**TL239/1000CAM(K)E4**	1 845 000	4 882 500	150	190

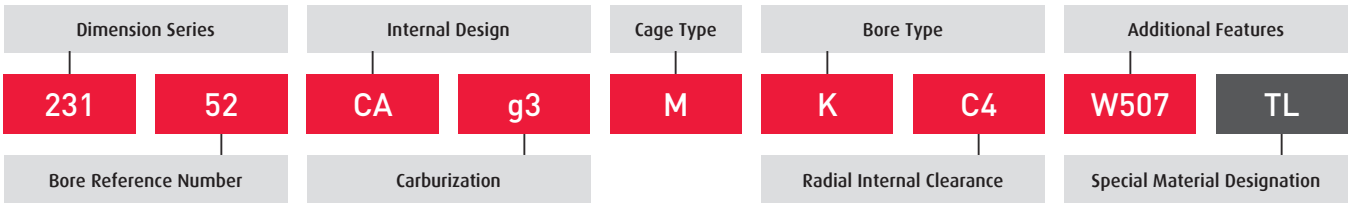


230 239 241

ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
d_a		D_a		r_a					
min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
738	-	922	883	5.0	0.17	5.8	3.9	3.8	352.0
746	-	994	936	6.0	0.22	4.6	3.1	3.0	647.0
754	-	1 106	981	8.0	0.38	2.6	1.8	1.7	1730.0
778	-	972	931	5.0	0.17	6.0	4.1	4.0	398.0
786	-	1 054	990	6.0	0.22	4.6	3.1	3.0	768.0
828	-	1 032	987	5.0	0.17	6.0	4.0	3.9	462.0
836	-	1 114	1 045	6.0	0.21	4.7	3.2	3.1	870.0
878	-	1 092	1 046	5.0	0.16	6.2	4.2	4.1	523.0
886	-	1 184	1 109	6.0	0.21	4.8	3.2	3.1	1020.0
986	-	1 214	1 169	6.0	0.16	6.3	4.2	4.1	732.0
986	-	1 324	1 241	6.0	0.21	4.8	3.2	3.2	1400.0
1 036	-	1 284	1 229	6.0	0.16	6.4	4.3	4.2	881.0

DESIGNATION SYSTEM - AFTERMARKET

TL SERIES SPHERICAL ROLLER BEARINGS



DESIGNATION		ATTRIBUTE
Dimension Series	222	medium duty type
	223	heavy duty type
	230	very light duty type
	231	light duty type
	232	medium duty type, wide
	239	extra-light duty type
Bore Reference Number		multiply x 5 for bore diameter in mm; 500 mm and greater expressed with a "/" eg. /500 = 500 mm
Internal Design	EA	high capacity design, steel cage
	CA	high capacity design, brass cage
Carburization	g	complete bearing
	g3	inner ring
	g5	inner and outer ring
Cage Type	blank	two piece steel cage
	CD[1]	two piece steel cage with guide ring
	M	machined brass cage with guide ring
Bore Type	blank	cylindrical bore
	K	1:12 tapered bore
Radial Internal Clearance	blank	normal (CN)
	C3	greater than normal
	C4	greater than C3
	C5	greater than C4

DESIGNATION		ATTRIBUTE
Additional Features	P55	extra-close running accuracy, inner and outer ring
	S11	dimensionally stabilized up to 200°C
	W31	special inspection measure of superior raceway finish + upgraded packaging
	W507	W31 + lubrication groove and holes in the outer ring (E4) + S11
	W509	W31 + lubrication groove and holes in the outer and inner ring (E7) + S11
Special Material Designation	TL	Tough and Long Life material technology

1) When cage type CD is used, it follows the bore reference number in the designation system eg. 23028CDg3KC4W507TL

NSK

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