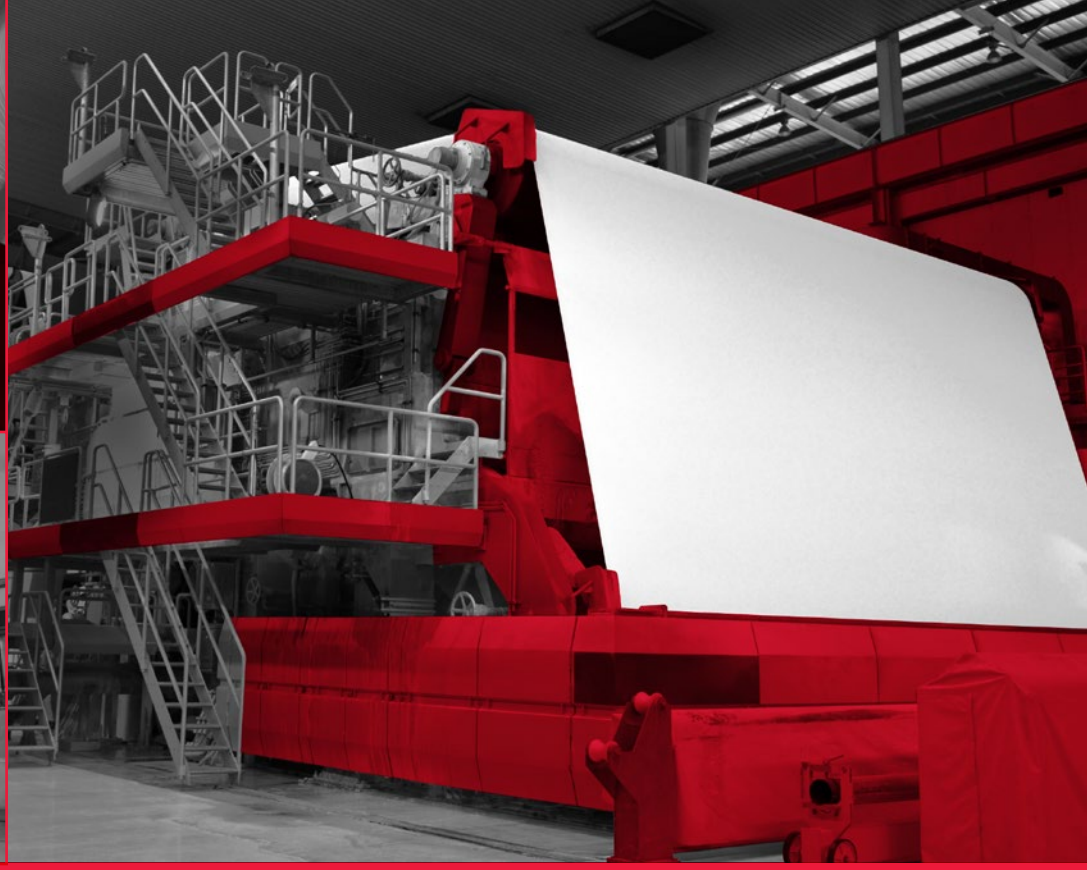
TL SERIES SPHERICAL ROLLER BEARINGS

TOUGH AND LONG-LIFE PERFORMANCE IN PAPER MACHINES

STAY IN MOTION. STAY IN CONTROL.



AT HIGH SPEEDS, 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

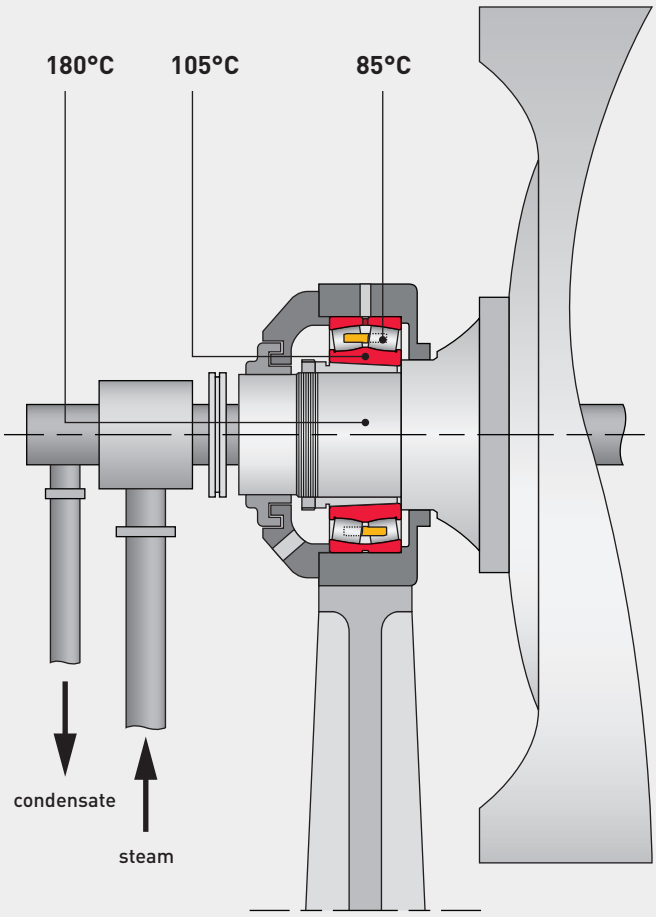
TL STEEL TECHNOLOGY: THE LONG-LIFE SOLUTION

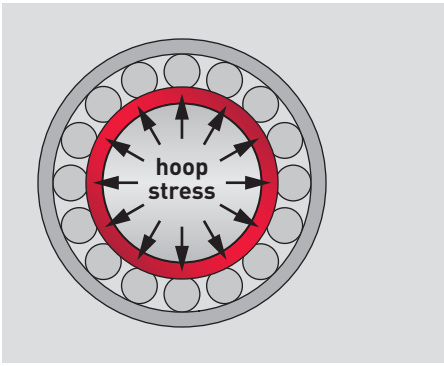
FAILURE MECHANISM IN PAPER MACHINE DRYER ROLLS

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

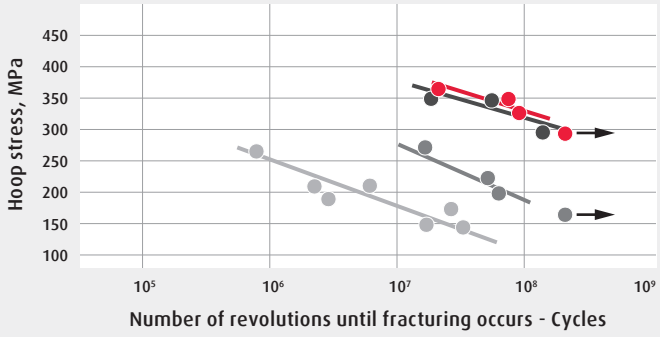
At bottom right:
The journal expands faster than the bearing inner ring, creating an extremely tight shaft fit and causing severe hoop stress

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.

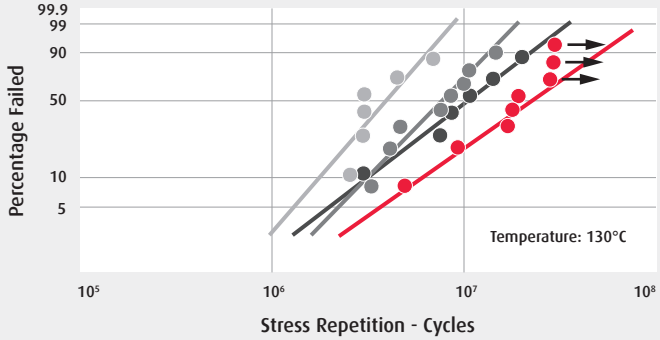
- TL specification steel
- Carburized steel
- Bearing steel with bainite treatment
- Bearing steel with standard heat treatment



Longer Fatigue Life

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

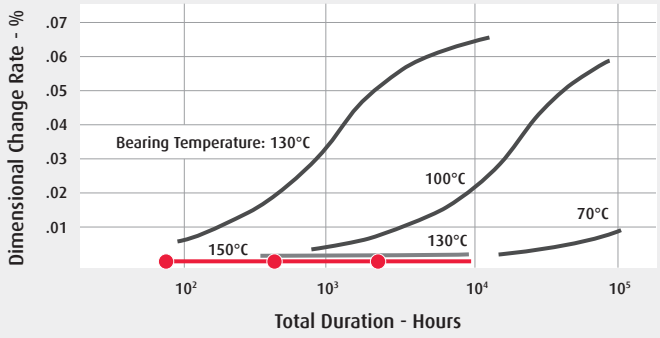
- TL specification steel
- Carburized steel with dimensional stabilizing treatment
- Bearing steel with bainite treatment
- Bearing steel with dimensional stabilizing treatment



Dimensional Stability

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

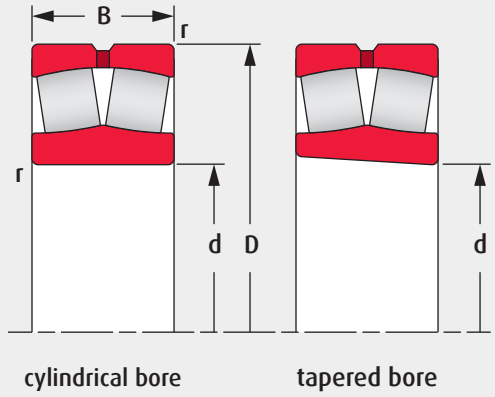
- TL specification steel
- Bearing steel with standard heat treatment
- Bearing steel with dimensional stabilizing treatment

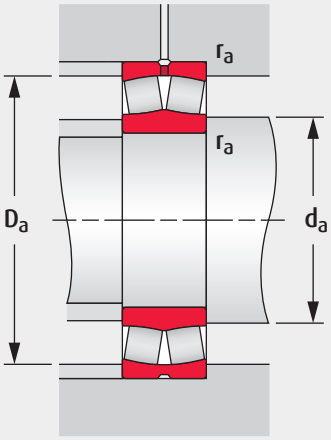


NSK's TL series spherical roller bearings are ideally designed to deliver Tough and Long Life performance wherever elevated temperatures prevail in the paper making process - in dryer rolls, canvas rolls, PV rolls and calender rolls.

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:

$P = XF_r + YF_a$

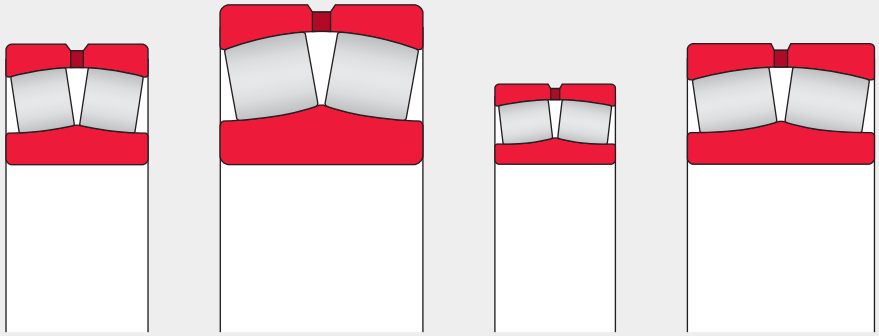
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

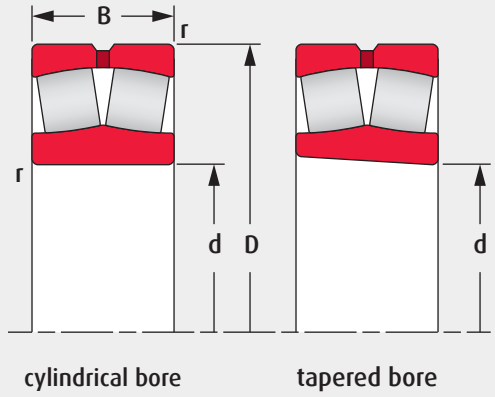
BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL22308CAME4	TL22308CAMKE4	40	90	33	1.5	122	129	27 500	29 000
TL22311CAME4	TL22311CAMKE4	55	120	43	2.0	209	241	47 000	54 000
TL22312CAME4	TL22312CAMKE4	60	130	46	2.1	246	288	55 500	64 500
TL22313EAE4	TL22313EAKE4	65	140	48	2.1	375	380	84 500	85 500
TL22314EAE4	TL22314EAKE4	70	150	51	2.1	425	435	95 500	98 000
TL22315CAME4	TL22215CAMKE4	75	130	31	2.1	340	415	76 500	93 500
TL22316CAME4	TL22316CAMKE4	80	170	58	2.1	390	480	87 500	108 000
TL22318EAE4	TL22318EAKE4	90	190	64	3.0	665	705	149 500	158 500
TL22319CAME4	TL22319CAMKE4	95	200	67	3.0	525	675	118 000	151 500
TL22320EAE4	TL22320EAKE4	100	215	73	3.0	860	930	193 500	209 000
TL23022CDE4	TL23022CDKE4	110	170	45	2.0	293	465	66 000	104 500
TL23222CE4	TL23222CKE4		200	69.8	2.1	515	760	116 000	171 000
TL22322EAE4	TL22322EAKE4		240	80	3.0	1 030	1 120	231 500	252 000
TL22324EAE4	TL22324EAKE4	120	260	86	3.0	1 190	1 320	267 500	296 500
TL22326CAME4	TL22326CAMKE4	130	280	93	4.0	995	1 350	223 500	303 500
TL23028CDE4	TL23028CDKE4	140	210	53	2.0	420	715	94 500	160 500
TL22228CDE4	TL22228CDKE4		250	68	3.0	645	930	145 000	209 000
TL23228CE4	TL23228CKE4		250	88	3.0	835	1 300	187 500	292 500

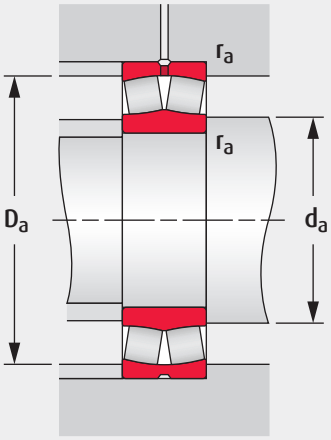


222 223 230 232

LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
5 300	6 700	49	-	81	77	1.5	0.38	2.6	1.8	1.7	1.0
3 800	4 800	65	-	110	103	2.0	0.36	2.8	1.9	1.8	2.3
3 600	4 500	72	-	118	111	2.0	0.36	2.8	1.9	1.9	2.9
3 200	4 000	77	84	128	119	2.0	0.33	3.0	2.0	2.0	3.5
3 000	3 800	82	91	138	129	2.0	0.33	3.0	2.0	2.0	4.3
2 800	3 600	87	-	148	134	2.0	0.35	2.9	2.0	1.9	3.6
2 600	3 400	92	-	158	145	2.0	0.35	2.9	2.0	1.9	6.2
2 400	3 000	104	115	176	163	2.5	0.33	3.1	2.1	2.0	8.6
2 200	2 800	109	-	186	172	2.5	0.35	2.9	1.9	1.9	9.9
2 000	2 600	114	130	201	184	2.5	0.33	3.0	2.0	2.0	12.7
2 000	2 400	120	124	160	153	2.0	0.24	4.2	2.8	2.8	3.8
1 500	1 900	122	130	188	170	2.0	0.34	3.0	2.0	1.9	9.5
1 700	2 200	124	145	226	206	2.5	0.30	3.1	2.1	2.0	17.6
1 600	2 000	134	157	246	222	2.5	0.32	3.1	2.1	2.0	22.2
1 300	1 600	148	-	262	236	3.0	0.34	2.9	2.0	1.9	27.8
1 600	1 900	150	157	200	190	2.0	0.22	4.5	3.0	2.9	6.5
1 400	1 700	154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
1 100	1 500	154	163	236	213	2.5	0.25	2.9	1.9	1.9	18.8

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

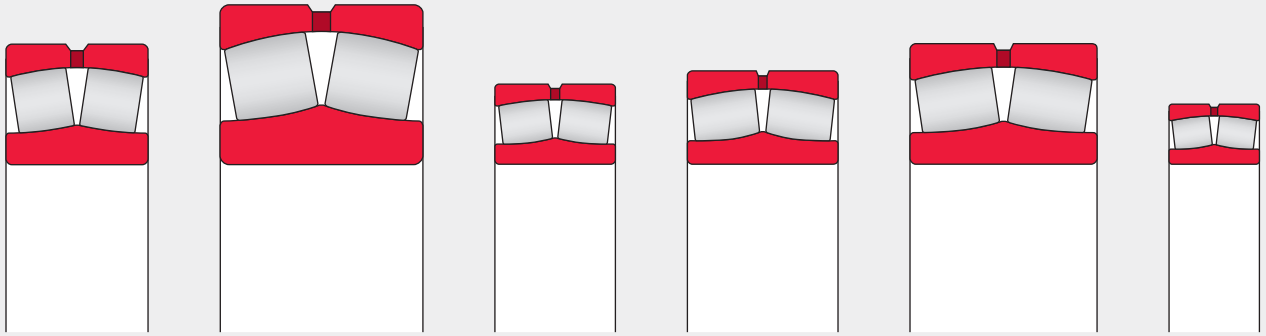
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

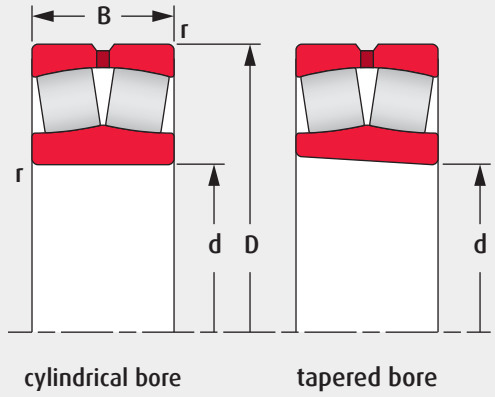
BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL23030CAME4	TL23030CAMKE4	150	225	56	2.1	470	815	105 500	183 000
TL23130CAME4	TL23130CAMKE4		250	80	2.1	725	1 180	163 000	265 500
TL22230CDE4	TL22230CDKE4		270	73	3.0	765	1 120	172 000	252 000
TL22330CAME4	TL22330CAMKE4		320	108	4.0	1 220	1 690	274 500	380 000
TL23032CDE4	TL23032CDKE4	160	240	60	2.1	540	955	121 500	214 500
TL22232CDE4	TL22232CDKE4		290	80	3.0	910	1 320	204 500	296 500
TL23232CE4	TL23232CKE4		290	104	3.0	1 100	1 770	247 500	398 000
TL23934CAME4	TL23934CAMKE4	170	230	45	2.0	350	660	78 500	148 500
TL23034CDE4	TL23034CDKE4		260	67	2.1	640	1 090	144 000	245 000
TL23134CAME4	TL23134CAMKE4		280	88	2.1	940	1 570	211 500	353 000
TL22334CAME4	TL22334CAMKE4		360	120	4.0	1 580	2 110	355 000	474 500
TL23036CDE4	TL23036CDKE4	180	280	74	2.1	750	1 270	168 500	285 500
TL23236CAME4	TL23236CAMKE4		320	112	4.0	1 300	2 110	292 500	474 500
TL23038CAME4	TL23038CAMKE4	190	290	75	2.1	775	1 350	174 000	303 500
TL23138CAME4	TL23138CAMKE4		320	104	3.0	1 190	2 020	267 500	454 000
TL22238CAME4	TL22238CAMKE4		340	92	4.0	1 140	1 730	256 500	389 000
TL23238CAME4	TL23238CAMKE4		340	120	4.0	1 440	2 350	323 500	528 500
TL22338CAME4	TL22338CAMKE4		400	132	5.0	1 890	2 590	425 000	582 500

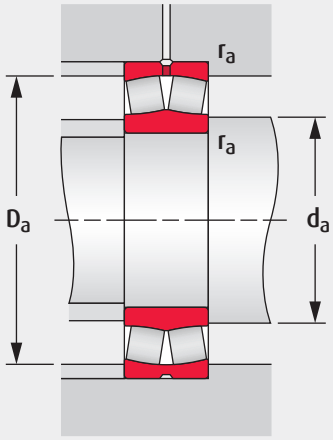


222 223 230 231 232 239

LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
1 400	1 800	162	-	213	203	2.0	0.22	4.6	3.1	3.0	7.9
1 100	1 400	162	-	238	218	2.0	0.30	3.4	2.3	2.2	15.8
1 300	1 600	164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
1 100	1 400	168	-	302	270	3.0	0.35	2.9	1.9	1.9	41.5
1 300	1 700	172	179	228	216	2.0	0.22	4.5	3.0	2.9	9.7
1 200	1 500	174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
1 000	1 300	174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5
1 400	1 800	180	-	220	213	2.0	0.17	5.8	3.9	3.8	5.4
1 200	1 600	182	191	248	233	2.0	0.23	4.3	2.9	2.9	13.0
1 000	1 300	182	-	268	245	2.0	0.29	3.5	2.3	2.3	21.0
1 000	1 200	188	-	342	304	3.0	0.35	2.9	1.9	1.9	57.9
1 200	1 400	192	202	268	249	2.0	0.24	4.2	2.8	2.8	17.1
850	1 100	198	-	302	274	3.0	0.35	2.9	1.9	1.9	38.5
1 100	1 400	202	-	278	261	2.0	0.24	4.2	2.8	2.8	17.6
850	1 100	204	-	306	276	3.5	0.31	3.2	2.2	2.1	34.0
1 000	1 200	208	-	322	296	3.0	0.26	3.8	2.6	2.5	35.5
800	1 100	208	-	322	288	3.0	0.35	2.9	1.9	1.9	46.5
900	1 100	212	-	378	338	4.0	0.34	2.9	2.0	1.9	77.6

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

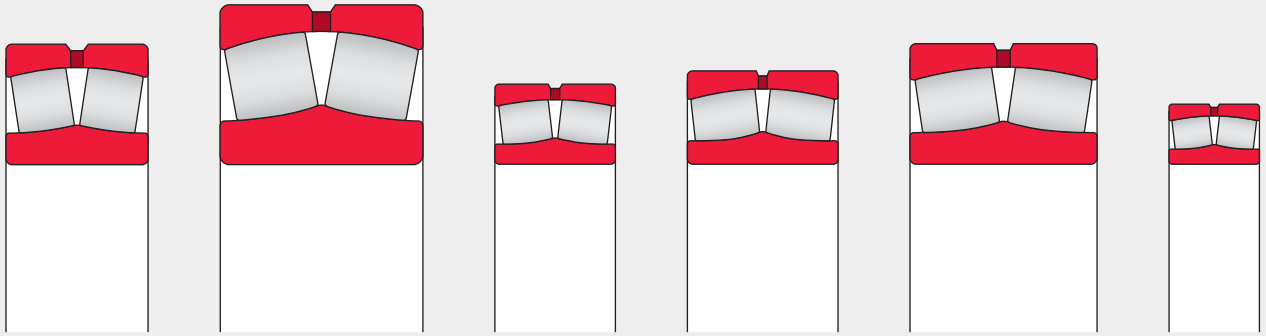
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL23040CAME4	TL23040CAMKE4	200	310	82	2.1	940	1 700	211 500	382 000
TL23140CAME4	TL23140CAMKE4		340	112	3.0	1 360	2 330	305 500	524 000
TL22240CAME4	TL22240CAMKE4		360	98	4.0	1 300	2 010	292 500	452 000
TL23240CAME4	TL23240CAMKE4		360	128	4.0	1 660	2 750	373 000	618 000
TL23044CAME4	TL23044CAMKE4	220	340	90	3.0	1 090	1 980	245 000	445 000
TL23144CAME4	TL23144CAMKE4		370	120	4.0	1 570	2 710	353 000	609 000
TL22244CAME4	TL22244CAMKE4		400	108	4.0	1 570	2 430	353 000	546 500
TL23244CAME4	TL23244CAMKE4		400	144	4.0	2 520	3 400	566 500	764 500
TL22344CAME4	TL22344CAMKE4		460	145	5.0	2 350	3 400	528 500	764 500
TL23948CAME4	TL23948CAMKE4	240	320	60	2.1	635	1 300	143 000	292 500
TL23048CAME4	TL23048CAMKE4		350	92	3.0	1 160	2 140	261 000	481 000
TL23148CAME4	TL23148CAMKE4		400	128	4.0	1 790	3 100	402 500	697 000
TL22348CAME4	TL22348CAMKE4		500	155	5.0	2 600	3 800	584 500	854 500
TLI-112618CAME4	TLI-112618CAMKE4	250	410	128	4.0	1 780	3 150	400 000	708 000
TL23952CAME4	TL23952CAMKE4	260	350	75	2.1	930	1 870	209 000	420 500
TL23052CAME4	TL23052CAMKE4		400	104	4.0	1 430	2 580	321 500	580 000
TL23152CAME4	TL23152CAMKE4		440	144	4.0	2 160	3 750	485 500	843 000



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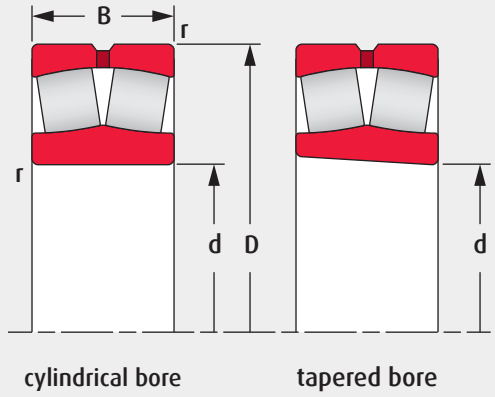
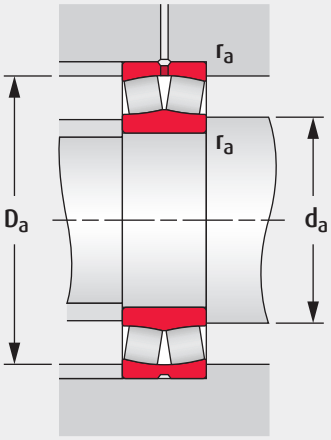
LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
1 000	1 300	212	-	298	279	2.0	0.25	4.0	2.7	2.6	22.6
800	2 000	214	-	326	293	2.5	0.32	3.2	2.1	2.1	41.5
950	1 200	218	-	342	315	3.0	0.26	3.8	2.6	2.5	42.6
750	1 000	218	-	342	307	3.0	0.35	2.9	1.9	1.9	57.0
950	1 200	234	-	326	302	2.5	0.24	4.1	2.8	2.7	29.7
710	950	238	-	352	320	3.0	0.31	3.2	2.2	2.1	52.0
850	1 000	238	-	382	348	3.0	0.27	3.7	2.5	2.4	59.0
670	900	238	-	382	337	3.0	0.36	2.8	1.9	1.8	79.5
750	950	242	-	438	391	4.0	0.33	3.0	2.0	2.0	116.0
950	1 200	252	-	308	298	2.0	0.17	6.0	4.0	3.9	13.3
850	1 100	254	-	346	324	2.5	0.24	4.2	2.8	2.7	32.6
670	850	258	-	382	347	3.0	0.31	3.3	2.2	2.2	64.5
670	850	262	-	478	423	4.0	0.32	3.2	2.1	2.1	147.0
640	840	268	-	392	357	3.0	0.30	3.4	2.2	2.2	65.2
850	1 000	272	-	348	333	2.0	0.19	5.4	3.6	3.5	23.0
800	950	278	-	382	356	3.0	0.25	4.1	2.7	2.7	46.6
600	800	278	-	422	380	3.0	0.32	3.2	2.1	2.1	88.2

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

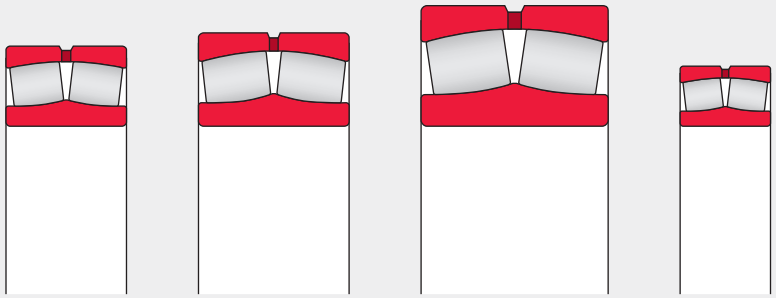
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

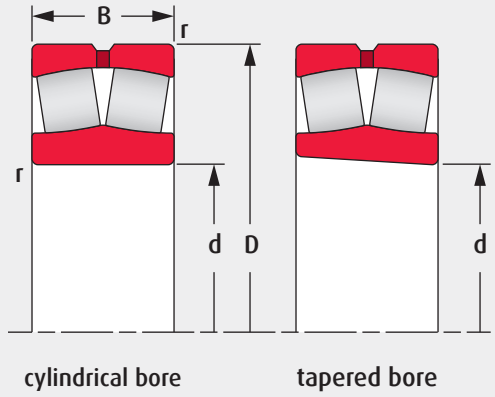
BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL23956CAME4	TL23956CAMKE4	280	380	75	2.1	925	1 950	208 000	438 500
TL23056CAME4	TL23056CAMKE4		420	106	4.0	1 540	2 950	346 000	663 000
TL23156CAME4	TL23156CAMKE4		460	146	5.0	2 230	4 000	501 500	899 000
TL23256CAME4	TL23256CAMKE4		500	176	5.0	2 880	4 900	647 500	1 101 500
TL23960CAME4	TL23960CAMKE4	300	420	90	3.0	1 230	2 490	276 500	560 000
TL23060CAME4	TL23060CAMKE4		460	118	4.0	1 920	3 700	431 500	832 000
TL23160CAME4	TL23160CAMKE4		500	160	5.0	2 670	4 800	600 000	1 079 000
TL23260CAME4	TL23260CAMKE4		540	192	5.0	3 400	5 900	764 500	1 326 500
TL23164CAME4	TL23164CAMKE4	320	540	176	5.0	3 050	5 500	685 500	1 236 500
TL23068CAME4	TL23068CAMKE4	340	520	133	5.0	2 280	4 400	512 500	989 000
TL23168CAME4	TL23168CAMKE4		580	190	5.0	3 600	6 600	809 500	1 483 500
TL23072CAME4	TL23072CAMKE4	360	540	134	4.0	2 390	4 700	537 500	1 056 500
TL23976CAME4	TL23976CAMKE4	380	520	106	4.0	1 870	4 100	420 500	921 500
TL23080CAME4	TL23080CAMKE4	400	600	148	5.0	2 970	5 900	667 500	1 326 500
TL23984CAME4	TL23984CAMKE4	420	560	106	4.0	1 870	4 250	420 500	955 500
TL23088CAME4	TL23088CAMKE4	440	650	157	6.0	3 150	6 350	708 000	1 427 500
TL23992CAME4	TL23992CAMKE4	460	620	118	4.0	2 220	4 950	499 000	1 113 000

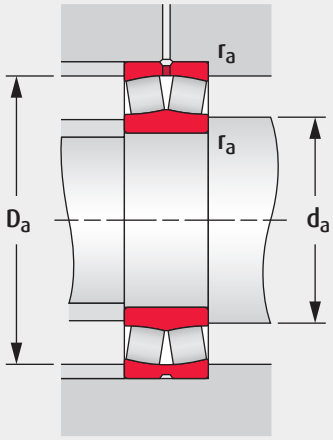


230 231 232 239

LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
800	950	292	-	368	351	2.0	0.18	5.7	3.9	3.8	24.5
710	900	298	-	402	377	3.0	0.24	4.2	2.8	2.7	50.5
560	750	302	-	438	400	4.0	0.30	3.3	2.2	2.2	94.3
530	670	302	-	478	425	4.0	0.35	2.9	1.9	1.9	147.0
710	900	314	-	406	386	2.5	0.19	5.2	3.5	3.4	38.2
670	850	318	-	442	413	3.0	0.24	4.2	2.8	2.7	70.5
500	670	322	-	478	433	4.0	0.31	3.3	2.2	2.2	125.0
480	630	322	-	518	458	4.0	0.35	2.9	1.9	1.9	189.0
480	600	342	-	518	466	4.0	0.31	3.2	2.1	2.1	162.0
560	710	362	-	458	465	4.0	0.24	4.2	2.8	2.8	101.0
430	560	362	-	558	499	4.0	0.31	3.2	2.1	2.1	206.0
530	670	382	-	518	485	4.0	0.24	4.2	2.8	2.8	106.0
530	670	398	-	502	482	3.0	0.18	5.5	3.7	3.6	65.4
480	600	422	-	578	540	4.0	0.23	4.4	3.0	2.9	146.0
500	600	438	-	542	521	3.0	0.17	6.0	4.0	3.9	71.6
430	530	468	-	622	587	5.0	0.23	4.3	2.9	2.8	173.0
430	530	478	-	602	573	3.0	0.17	5.9	4.0	3.9	100.0

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

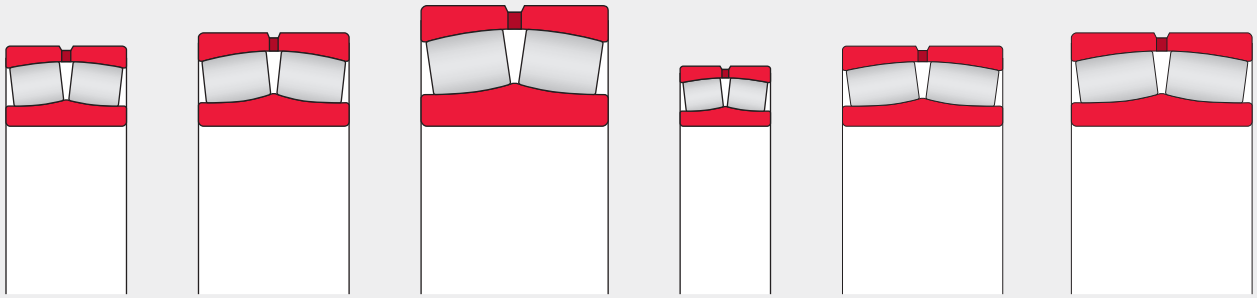
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

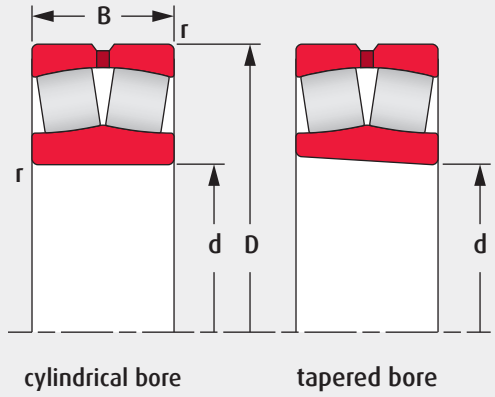
BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL239/500CAME4	TL239/500CAMKE4	500	670	128	5.0	2 460	5 550	553 000	1 247 500
TL230/500CAME4	TL230/500CAMKE4		720	167	6.0	3 750	8 100	843 000	1 821 000
TL240/500CAME4	TL240/500CAMKE4		720	218	6.0	4 450	9 900	1 001 500	2 227 500
TL231/500CAME4	TL231/500CAMKE4		830	264	7.5	6 850	13 400	1 540 000	3 012 500
TL241/500CAME4	TL241/500CAMKE4		830	325	7.5	8 000	16 000	1 800 000	3 600 000
TL232/500CAME4	TL232/500CAMKE4		920	336	7.5	9 000	16 600	2 023 500	3 732 000
TL239/530CAME4	TL239/530CAMKE4	530	710	136	5.0	2 930	6 800	658 500	1 528 500
TL230/530CAME4	TL230/530CAMKE4		780	185	6.0	4 400	9 200	989 000	2 068 000
TL240/530CAME4	TL240/530CAMKE4		780	250	6.0	5 400	11 800	1 215 000	2 655 000
TL231/530CAME4	TL231/530CAMKE4		870	272	7.5	7 150	14 100	1 607 500	3 170 000
TL241/530CAME4	TL241/530CAMKE4		870	335	7.5	8 500	17 500	1 912 500	3 937 500
TL232/530CAME4	TL232/530CAMKE4		980	355	9.5	10 100	18 800	2 270 500	4 226 500
TL239/560CAME4	TL239/560CAMKE4	560	750	140	5.0	3 100	7 250	697 000	1 630 000
TL230/560CAME4	TL230/560CAMKE4		820	195	6.0	5 000	10 700	1 124 000	2 405 500
TL240/560CAME4	TL240/560CAMKE4		820	258	6.0	5 950	13 300	1 339 000	2 992 500
TL231/560CAME4	TL231/560CAMKE4		920	280	7.5	7 850	15 500	1 765 000	3 484 500
TL241/560CAME4	TL241/560CAMKE4		920	355	7.5	9 400	19 600	2 115 000	4 410 000
TL232/560CAME4	TL232/560CAMKE4		1030	365	9.5	10 900	20 500	2 450 500	4 608 500

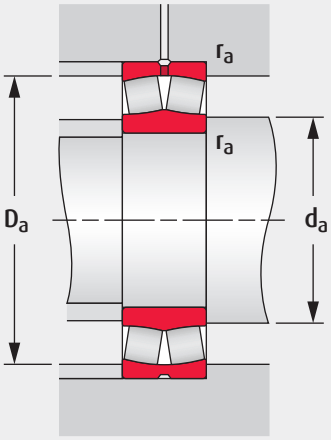


230 231 232 239 240 241

LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
400	500	522	-	648	622	4.0	0.17	6.0	4.0	3.9	124.0
380	480	528	-	692	655	5.0	0.21	4.8	3.2	3.1	220.0
300	400	528	-	692	643	5.0	0.30	3.4	2.3	2.2	276.0
280	360	536	-	794	720	6.0	0.31	3.2	2.2	2.1	567.0
280	360	536	-	794	703	6.0	0.39	2.6	1.7	1.7	666.0
260	320	536	-	884	773	6.0	0.38	2.7	1.8	1.8	969.0
360	450	552	-	688	659	4.0	0.17	6.0	4.0	3.9	149.0
340	430	558	-	752	706	5.0	0.22	4.6	3.1	3.0	298.0
280	360	558	-	752	690	5.0	0.31	3.3	2.2	2.2	390.0
260	340	566	-	834	758	6.0	0.30	3.3	2.2	2.2	628.0
260	340	566	-	834	740	6.0	0.38	2.6	1.8	1.7	773.0
240	300	574	-	936	824	8.0	0.38	2.7	1.8	1.7	1 170.0
340	430	582	-	728	697	4.0	0.16	6.1	4.1	4.0	172.0
320	400	588	-	792	742	5.0	0.22	4.5	3.0	2.9	344.0
260	340	588	-	792	729	5.0	0.30	3.3	2.2	2.2	440.0
240	320	596	-	884	804	6.0	0.30	3.4	2.3	2.2	727.0
240	320	596	-	884	782	6.0	0.39	2.6	1.8	1.7	886.0
220	280	604	-	986	870	8.0	0.36	2.8	1.9	1.8	1 320.0

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

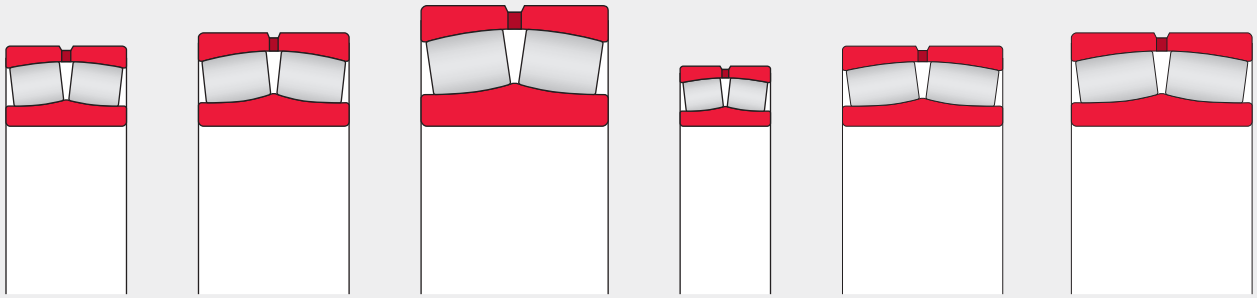
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

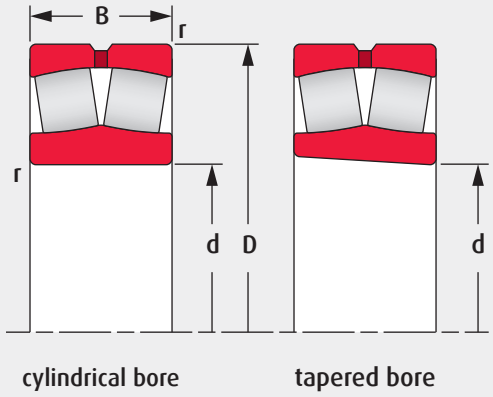
BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL239/600CAME4	TL239/600CAMKE4	600	800	150	5.0	3 450	8 100	775 500	1 821 000
TL230/600CAME4	TL230/600CAMKE4		870	200	6.0	5 450	12 200	1 225 000	2 742 500
TL240/600CAME4	TL240/600CAMKE4		870	272	6.0	6 600	15 100	1 485 000	3 397 500
TL231/600CAME4	TL231/600CAMKE4		980	300	7.5	8 750	17 500	1 967 000	3 934 000
TL241/600CAME4	TL241/600CAMKE4		980	375	7.5	10 400	21 900	2 340 000	4 927 500
TL232/600CAME4	TL232/600CAMKE4		1 090	388	9.5	12 700	24 900	2 855 000	5 597 500
TL239/630CAME4	TL239/630CAMKE4	630	850	165	6.0	4 000	9 350	899 000	2 102 000
TL230/630CAME4	TL230/630CAMKE4		920	212	7.5	5 900	12 700	1 326 500	2 855 000
TL231/630CAME4	TL231/630CAMKE4		1 030	315	7.5	9 600	19 400	2 158 000	4 361 500
TL241/630CAME4	TL241/630CAMKE4		1 030	400	7.5	11 300	23 900	2 542 500	5 377 500
TL239/670CAME4	TL239/670CAMKE4	670	900	170	6.0	4 350	10 300	979 000	2 317 500
TL230/670CAME4	TL230/670CAMKE4		980	230	7.5	6 850	15 000	1 541 500	3 375 000
TL241/670CAME4	TL241/670CAMKE4		1 090	412	7.5	12 400	26 500	2 790 000	5 962 500

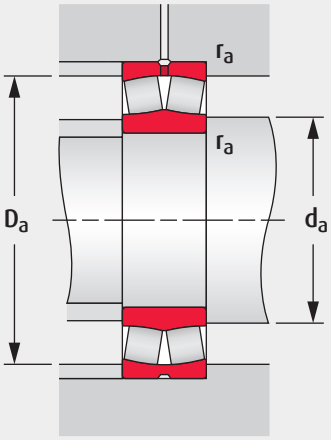


230 231 232 239 240 241

LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
320	400	622	-	778	745	4.0	0.17	5.9	3.9	3.9	205.0
300	360	628	-	842	794	5.0	0.21	4.8	3.3	3.2	389.0
240	320	628	-	842	772	5.0	0.30	3.3	2.2	2.2	529.0
220	280	636	-	944	856	6.0	0.30	3.4	2.3	2.2	898.0
220	280	636	-	944	836	6.0	0.39	2.6	1.8	1.7	1050.0
200	260	644	-	1 046	923	8.0	0.36	2.8	1.9	1.8	1590.0
300	360	658	-	822	786	5.0	0.18	5.6	3.8	3.7	259.0
280	340	666	-	884	835	6.0	0.22	4.7	3.1	3.1	468.0
200	260	666	-	994	900	6.0	0.30	3.4	2.3	2.2	1 040.0
200	260	666	-	994	876	6.0	0.38	2.7	1.8	1.7	1 250.0
260	340	698	-	872	836	5.0	0.17	5.8	3.9	3.8	300.0
240	320	706	-	944	891	6.0	0.22	4.7	3.1	3.1	571.0
190	240	706	-	1 054	934	6.0	0.37	2.7	1.8	1.8	1 440.0

BEARING DIMENSIONS AND OPERATING VALUES





Dynamic equivalent load:

$P = XF_r + YF_a$

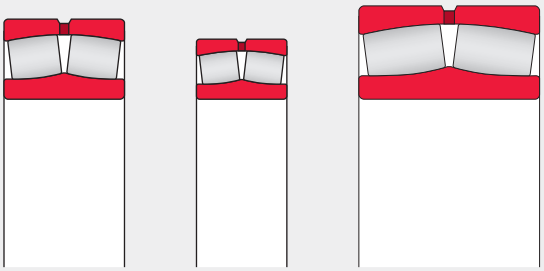
$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

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.

BASIC BEARING NO.		BEARING DIMENSIONS				BASIC LOAD RATINGS			
		mm				kN		lbf	
cylindrical bore	tapered bore	d	D	B	r (min)	dynamic	static	dynamic	static
TL239/710CAME4	TL239/710CAMKE4	710	950	180	6.0	4 800	11 700	1 080 000	2 632 500
TL230/710CAME4	TL230/710CAMKE4		1 030	236	7.5	7 100	15 800	1 597 500	3 555 000
TL241/710CAME4	TL241/710CAMKE4		1 150	438	9.5	13 900	30 500	3 127 500	6 862 500
TL239/750CAME4	TL239/750CAMKE4	750	1 000	185	6.0	5 250	12 800	1 181 500	2 880 000
TL230/750CAME4	TL230/750CAMKE4		1 090	250	7.5	7 750	17 200	1 744 000	3 870 000
TL239/800CAME4	TL239/800CAMKE4	800	1 060	195	6.0	5 600	13 700	1 260 000	3 082 500
TL230/800CAME4	TL230/800CAMKE4		1 150	258	7.5	8 350	19 100	1 879 000	4 297 500
TL239/850CAME4	TL239/850CAMKE4	850	1 120	200	6.0	6 100	15 200	1 372 500	3 420 000
TL230/850CAME4	TL230/850CAMKE4	850	1 220	272	7.5	9 300	21 400	2 092 500	4 815 000
TL239/950CAME4	TL239/950CAMKE4	950	1 250	224	7.5	7 600	19 900	1 710 000	4 477 500
TL230/950CAME4	TL230/950CAMKE4	950	1 360	300	7.5	11 300	26 500	2 542 500	5 962 500
TL239/1000CAME4	TL239/1000CAMKE4	1 000	1 320	236	7.5	8 200	21 700	1 845 000	4 882 500

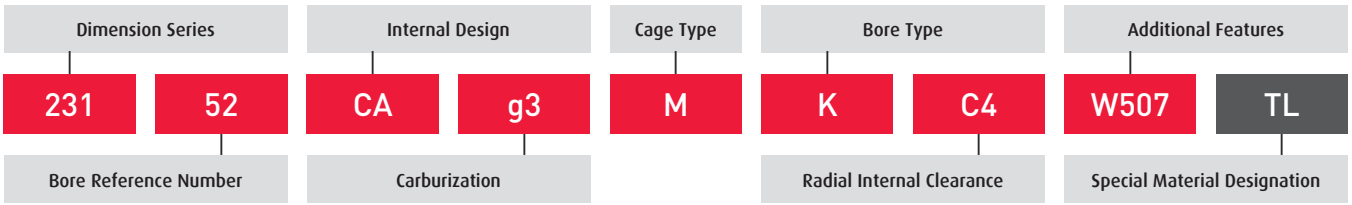


230 239 241

LIMITING SPEEDS		ABUTMENT AND FILLET DIMENSIONS					CONSTANT	AXIAL LOAD FACTORS			MASS ~
rpm		d_a		D_a		r_a					
grease	oil	min	max	max	min	max	e	Y_2	Y_3	Y_0	kg
240	300	738	-	922	883	5.0	0.17	5.8	3.9	3.8	352.0
240	280	746	-	994	936	6.0	0.22	4.6	3.1	3.0	647.0
170	220	754	-	1 106	981	8.0	0.38	2.6	1.8	1.7	1 730.0
220	280	778	-	972	931	5.0	0.17	6.0	4.1	4.0	398.0
220	260	786	-	1 054	990	6.0	0.22	4.6	3.1	3.0	768.0
220	260	828	-	1 032	987	5.0	0.17	6.0	4.0	3.9	462.0
200	240	836	-	1 114	1 045	6.0	0.21	4.7	3.2	3.1	870.0
190	240	878	-	1 092	1 046	5.0	0.16	6.2	4.2	4.1	523.0
180	220	886	-	1 184	1 109	6.0	0.21	4.8	3.2	3.1	1 020.0
160	200	986	-	1 214	1 169	6.0	0.16	6.3	4.2	4.1	732.0
150	190	986	-	1 324	1 241	6.0	0.21	4.8	3.2	3.2	1 400.0
150	190	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
Dimensional 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

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

IMPROVEMENT PAYS

END-TO-END SERVICE DELIVERS CUSTOMER SUCCESS

Improvement never ends. And we never stop looking for better ways to support our customers in a complete, collaborative and continuous way. The focus of NSK isn't simply on a quick fix for immediate gain – it's about incremental and sustainable improvement to deliver long-term benefits.

When NSK is on-site, we're there to understand our customers' challenges and identify problems contributing to frequent bearing replacement, breakdowns caused by poor specification, high energy costs from inefficient product selection and lost production because of downtime. We collaborate with our customers to institute an **Asset Improvement Program (AIP)** that encompasses process and maintenance management, diagnostic and educational support to deliver measurable gains in output and cost-efficiency.

With NSK, our customers embark on a critical path to realizing improvements in equipment, productivity, people and financial performance.

aip
NSK experts

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