MOTION & CONTROL™

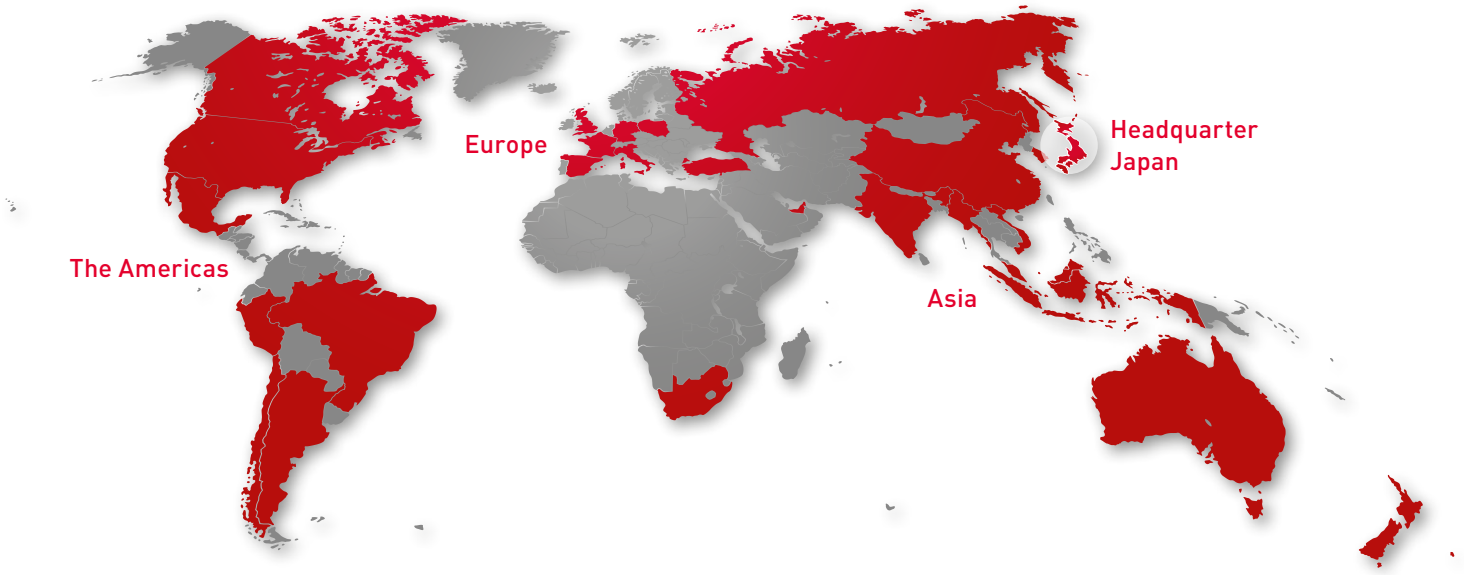
NSK

SOLUTIONS FOR PAPERMAKING MACHINES

SUBSCRIBE TO NSK NEWSLETTER

OUR MOST IMPORTANT PRODUCT: OUR CUSTOMERS' STATISFACTION

We are among the leading manufacturers for rolling bearings, linear technology components and steering systems worldwide. We can be found on almost every continent – with production facilities, sales offices and technology centres – because our customers appreciate short decision-making channels, prompt deliveries and local service.



The NSK company

NSK commenced operations as the first Japanese manufacturer of rolling bearings back in 1916. Ever since, we have been continuously expanding and improving not only our product portfolio but also our range of services for various industrial sectors. In this context our worlwide research and production facilities are linked together in a global network. Here we concentrate not only on the development of new technologies, but also on the continuous optimisation of quality – at every process stage. Among other things, our research activities include product design, simulation applications using a variety of analytical systems and the development of different steels and lubricants for rolling bearings.

More about NSK under: www.nskeurope.com

TABLE OF CONTENTS

THE HIGH QUALITY AND TOUGHNESS OF NSK BEARINGS REDUCE MAINTENANCE COSTS IN THE PAPERMAKING INDUSTRY

Bearings used in papermaking machines are operating under high-temperature conditions. These bearings are vulnerable to problems such as fracturing of the inner ring, which can result in work stoppages. NSK bearings, with their long service life, superior resistance to inner ring fractures, outstanding hardness, and excellent dimensional stability under high temperatures, produce solutions for a host of paper mill applications and operating environments.

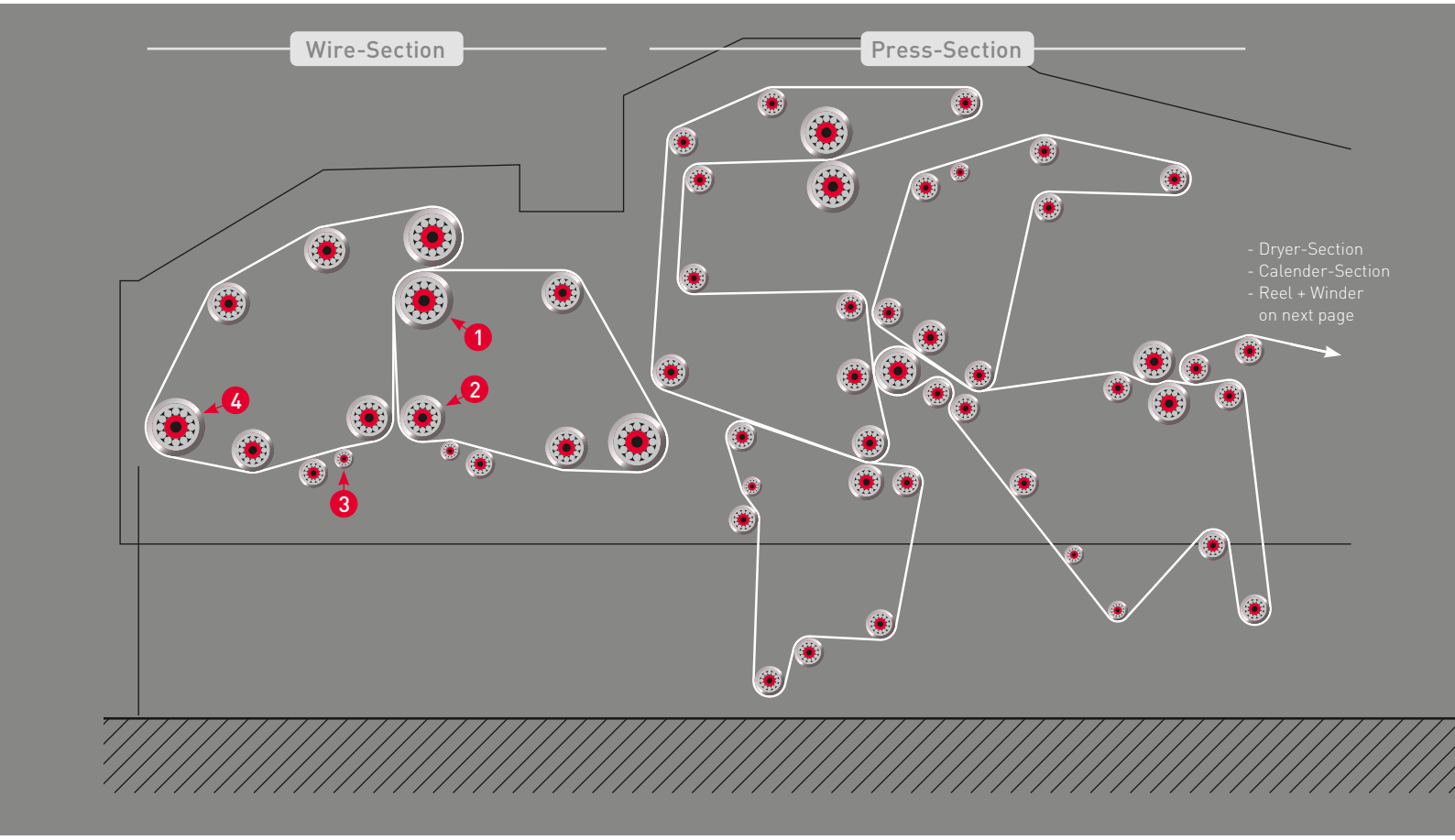
THE PAPERMAKING PROCESS AND SPHERICAL ROLLER BEARING SPECIFICATION – WIRE- AND PRESS-SECTION

1 Suction Couch Roll

Front	Back	Back-internal
1. SR	1. SR	1. SR
2. 320-1000	2. 260-420	2. 100-200
3. 239, 230XX	3. 230, 231XX	3. 223XX
4. C3 / P55	4. C3 / P55	4. C3 / P0
5. Oil circulation	5. Oil circulation	5. Grease

2 Breast Roll

1. TR (or SR)
2. 101,6-177,8
3. Inch series (or 223XX)
4. Normal or C3 / P0
5. Grease



3 Expander Roll

1. B
2. 75-190
3. 60, 62XX
4. Special / P0
5. Grease

4 Turning Roll

1. TR (or SR)
2. 101,6-177,8
3. Inch series (or 223XX)
4. Normal or C3 / P0
5. Grease

Key to Bearing Specifications

1. **Bearing type**
   SR: Spherical Roller Bearing
   TR: Tapered Roller Bearing
   B: Ball Bearing
2. **Bearing inner ring bore diameter**
3. **Bearing series**
4. **Internal clearance / tolerance class**
5. **Lubrication**
6. **Others**

THE PAPERMAKING PROCESS AND SPHERICAL ROLLER BEARING SPECIFICATIONS – DRYER- AND CALENDER-SECTION, REEL

Key to Bearing Specifications

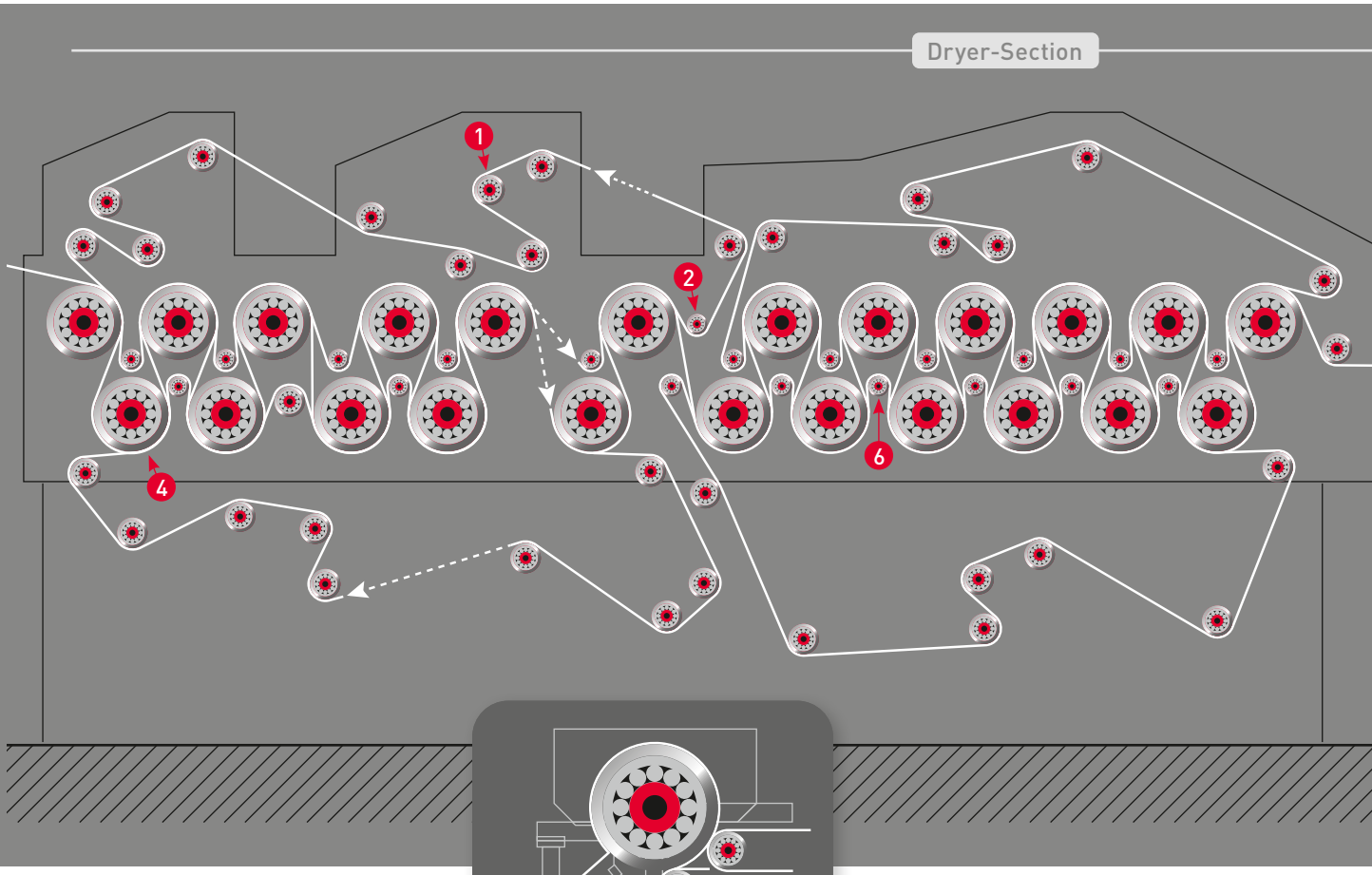
1. **Bearing type**
   SR: Spherical Roller Bearing
   TR: Tapered Roller Bearing
   B: Ball Bearing
2. **Bearing inner ring bore diameter**
3. **Bearing series**
4. **Internal clearance / tolerance class**
5. **Lubrication**
6. **Others**

1 Canvas Roll

1. SR
2. 50–110
3. 223XX
4. C3 / P0
5. Oil circulation
6. Heat treatment: TL or S11

2 Paper Roll

1. SR
2. 50–70
3. 223XX
4. C3 / P0
5. Oil circulation
6. Heat treatment: TL or S11



4 Drying Cylinder

1. SR
2. 160–300
3. 230, 231, 222, 232XX
4. C3 or C4 / P0
5. Oil circulation
6. Heat treatment: TL

5 Yankee Dryer

1. SR
2. 400–600
3. 230, 231XX
4. C3 or C4 / P0
5. Oil circulation
6. Heat treatment: TL or S11 or carburized steel + S11

6 PV Roll

1. SR
2. 90–380
3. 239, 231, 222, 223XX
4. C3 / P0
5. Oil circulation
6. Heat treatment: TL or S11

3 Breaker Stack Bottom Roll

1. SR
2. 320
3. 231XX
4. C3 / P55
5. Oil circulation
6. Heat treatment: TL or S11

7 Calender Top Roll

1. SR
2. 220–280
3. 230XX
4. Normal / P0
5. Oil circulation

8 Calender Queen Roll

1. SR
2. 160–320
3. 231XX
4. C3 / P0
5. Oil circulation

9 Calender Bottom Roll

1. SR
2. 240–530
3. 232XX
4. C3 / P0
5. Oil circulation
   CCR: Triple Ring Bearing

10 Reel Drum Roll

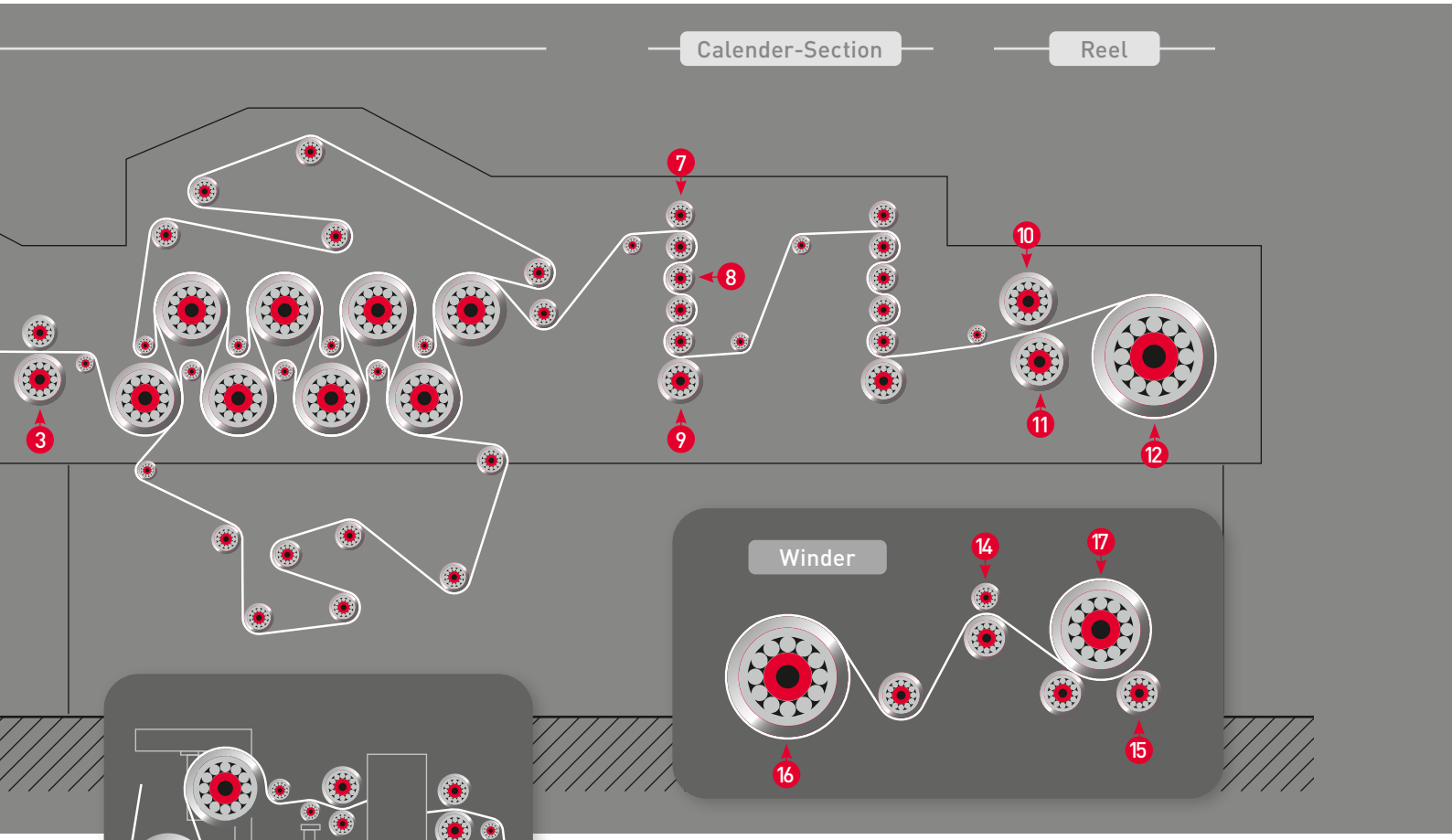
1. SR
2. 190
3. 222, 223XX
4. C3 / P0
5. Oil bath

11 Reel Spreader Roll

1. SR
2. 60—70
3. 223XX
4. Normal / P0
5. Grease

12 Reel Spool Roll

1. TR
2. 130—180
3. 322XX
4. Normal / P0
5. Grease



13 Soft Calender

1. SR
2. 400–600
3. 232, 241XX
4. C3 or C4 / P0 or P55
5. Oil circulation
6. Heat treatment: TL or S11
   or carburized steel + S11

14 Paper Roll

1. SR
2. 60–95
3. 223XX
4. C3 / P6
5. Oil bath or grease

15 Rider Roll

1. SR
2. 60–80
3. 222, 223XX
4. C3 / P6
5. Oil bath

16 Unwinding Stand

1. SR
2. 80–130
3. 222XX
4. C3 / P6 or P0
5. Oil bath

17 Winder Drum Roll

1. SR
2. 130–160
3. 223XX
4. C3 / P6
5. Oil bath

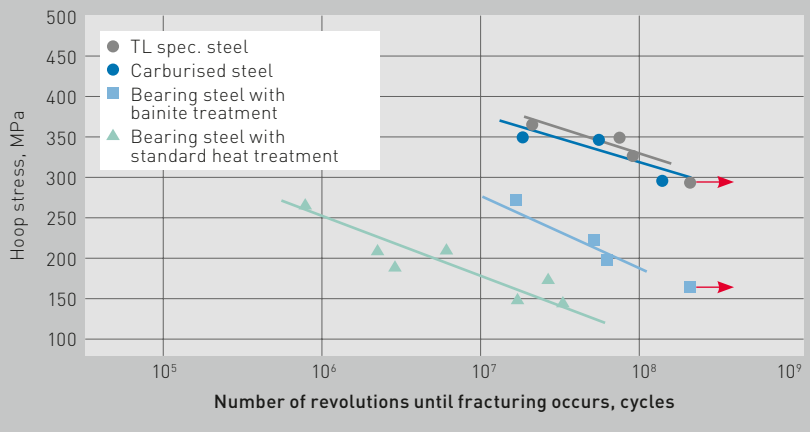
Spherical Roller Bearings – TL Series

Dryer rolls are generally used under high-temperature conditions, which can lead to fracturing of the bearing inner ring, and in the worst case, result in work stoppage. NSK's solution is the TL (Tough and Long-life) bearing, which features sufficient strength to resist inner ring fractures, superior dimensional stability under high- temperature conditions, and long life due to superior hardness. All these characteristics mean improved productivity.

Features

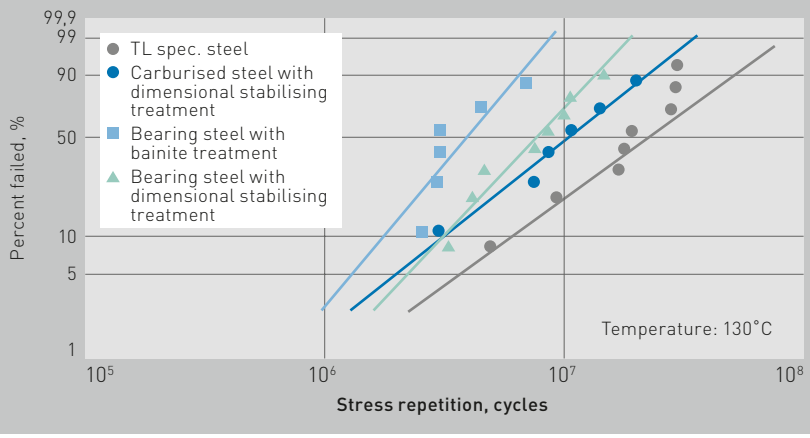
Enhanced inner ring strength

Adoption of a special steel and surface hardening heat treatment, developed by NSK, dramatically enhance inner ring strength against increasing hoop stress caused by rising shaft temperature.



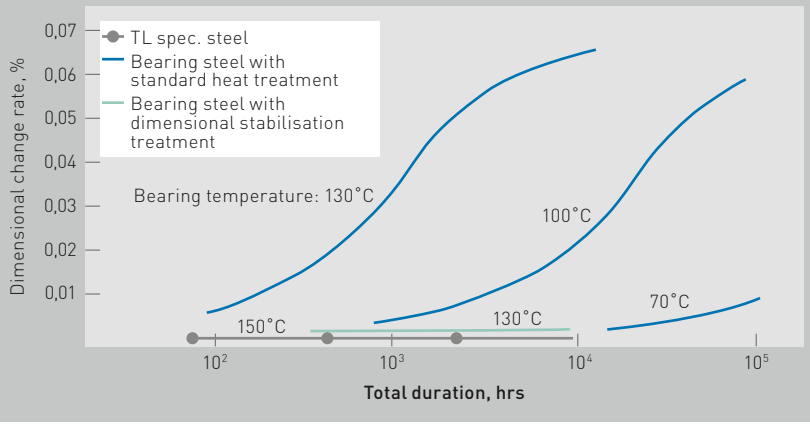
Longer life

Increased hardness of raceway surface provides longer life when foreign debris is present compared to other bearings.



Dimensional stability under high temperatures

High-temperature dimensional stabilisation of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology.



High Performance Standard Bearings for Industrial Machinery

NSKHPS, redefining the standard

Continually developing products with greater strength and higher accuracy, NSK's new NSKHPS fully incorporate the advantages of NSK's world-class design, materials, and manufacturing technologies, setting a new standard for bearings.

Features, compared with conventional bearings

Bearing life **2 times longer** (maximum)

Limiting speed **20 % higher** (maximum)

Working temperature up to **200°C**

1. Improved reliability

Bearing life has increased by a maximum of 2 times compared to conventional bearings by optimisation of the bearing's internal design and improved processing technology. As a result, the NSKHPS bearings contribute to reducing maintenance costs and facilitate the downscaling of related equipment.

2. Improved limiting speed (EA type)

Limiting speed has been increased by a maximum of 20 % compared to conventional bearings by improving cage wear resistance.

3. High temperature dimensional stabilizing treatment comes standard

High-temperature dimensional stabilization of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology. As a result, this series of bearing can be used in a wide range of applications.

Spherical Roller Bearings – CA Series

CA series bearings have high load capacity, superior durability, and wear resistance featuring a brass cage for various types of large rolls such as suction rolls, press rolls, calender rolls, and reel drum rolls, etc.
The CA series is available in a wide selection of sizes and other specifications, such as bearings with a lubricant hole and groove provided in the outer ring (E4), high heat-resistant bearings capable of withstanding up to 200°C (S11), and high-precision bearings (class 5).

Deep Groove Ball Bearings for High-speed Expander Rolls

Special bearings offer low frictional torque and minimize surface damage, such as smearing and others, through optimal design of the bearing interior and the adoption of coating treatment on the inner and outer rings.
The bearings are characterised by high performance and quality including low-noise bearings suitable for motors and pumps.

Molded-Oil Bearings

Molded-Oil bearings are lubricated with NSK's own oil-impregnated material, Molded-Oil consists of lubricating oil and polyolefin resin that has an affinity for oil. Lubricant slowly seeping from this material provides ample lubrication to the bearing for extended periods.

Features

Excellent performance in water- and dust-contaminated environments

The bearings are designed to prevent liquids such as water, which can wash out the lubricating oil, and dust from getting inside the bearings. Sealed types can be used in environments exposed to water and dust.

*Water and dust dramatically accelerate bearing damage. In order to realize stable operation, we recommend using seals to prevent water and dust from getting in the bearing.

Optimal composition and molding methods enable high-speed operation

Optimization of composition and molding method of Molded-Oil improves strength and enables high-speed operation.

Low torque

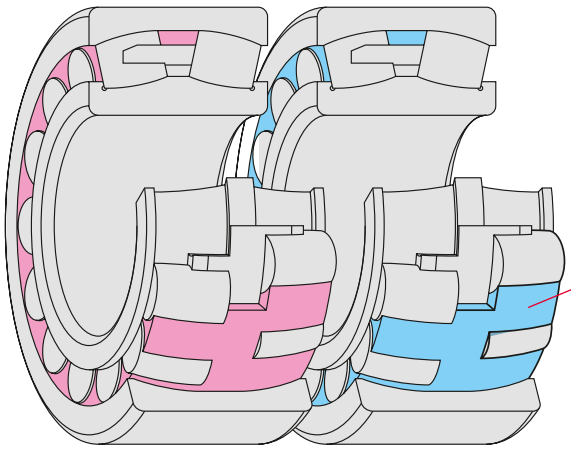
Packing with Molded-Oil after providing the bearing surface with special treatment realizes smooth rotation of rolling elements.

Environmentally friendly

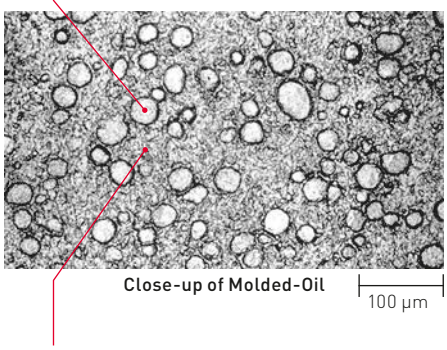
The bearings are lubricated by minute quantities of oil exuded by Molded-Oil, which consequently minimizes oil leakage.

Applications

Material processing equipment (conveyers, agitators), paper mill line equipment (support for wire part rolls), maintenance facilities (carrier rope sheave pulley), and carrier line equipment



For general use For high-speed operation



These bearings have certain restrictions in regards to ambient operating temperatures and limiting speeds ($d_m n$).

Cylindrical Roller Bearings – EM Series

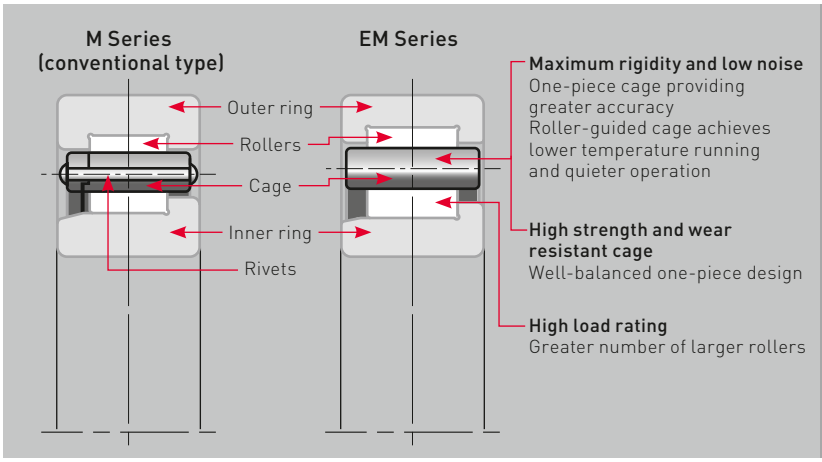
The high-load capacity standard cylindrical roller bearing delivers outstanding performance across a wide range of applications.
High-load capacity is achieved by using more rollers than conventional bearings based on an innovative NSK concept. We also offer standard cylindrical roller bearings for today's needs that provide longer service life and low-noise and low-vibration performance through an optimally designed one-piece cage with high rigidity and low wear.

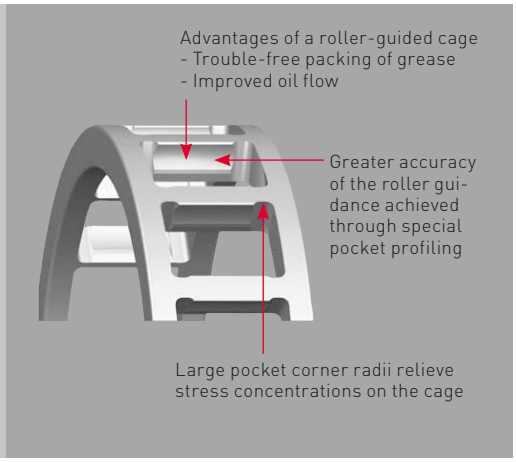
Features:

Available with innerring bore:
25 mm to 200 mm

Advantages to M Series:

Bearing life approximately 2 times
Low vibration and noise 50 % to 60 % less
Cage strength dramatically enhanced (generated stress cut in half)



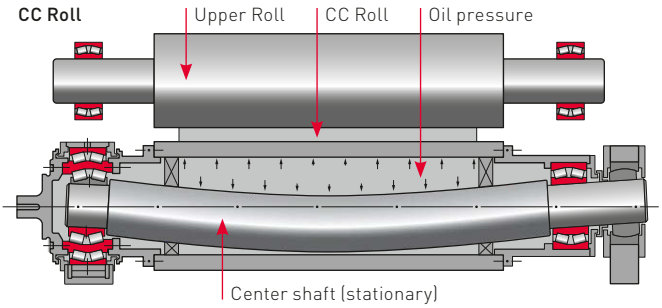


Triple Ring Bearings

Combination tapered roller bearings have typically been used for the outside of controlled crown rolls (CCR) and spherical roller bearings for the inside. Switching to high-precision, high load capacity triple ring bearings prevents creep, facilitates easier mounting, and extends operating life.

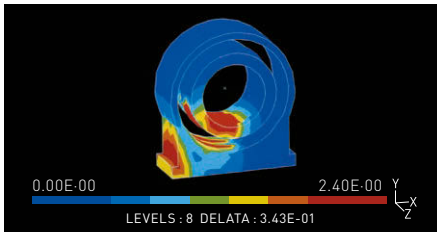
Features:

- **High-load capacity design**
- **Long life vacuum melted, carburised steel**
- **High precision (dimensional and rotational precision)**
- **Optimal inner ring design for lubrication**
- **Lubrication hole and groove provided on inner and outer rings**



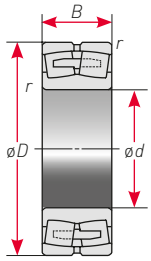
Finite element analysis of housing design for triple ring bearings.

Bearing load distribution is minimised by finite element method (FEM) analysis, thereby contributing to optimal structural design of the housing for paper machine manufacturers.

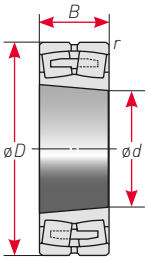


Maximum principle stress distribution

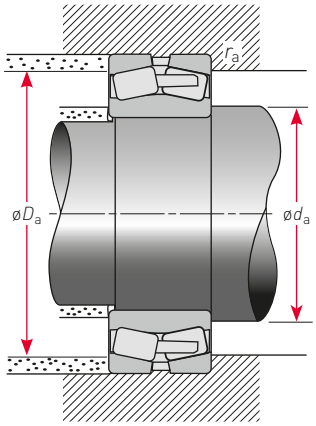
SPHERICAL ROLLER BEARINGS – TL SERIES



Cylindrical bore



Tapered bore



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

Dynamic Equivalent Load
$P = XF_r + YF_a$

Static Equivalent Load
$P_0 = F_r + Y_0F_a$

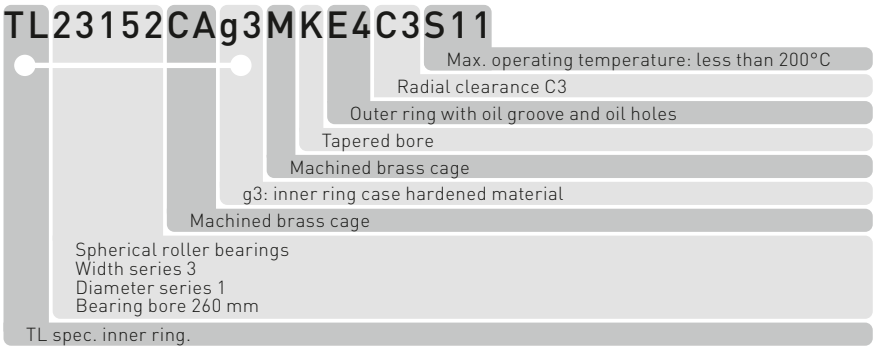
The values of e, Y_2, Y_3 and Y_0 are given in the table below.

Bearing Numbers		Boundary dimensions (mm)				Basic load ratings (N) (KN)		{kgf}
Cylindrical Bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{or}	C_r
TL22308CA E4	TL22308CA KE4	40	90	33	1.5	122	129	12 400
TL22311CA E4	TL22311CA KE4	55	120	43	2	209	241	21 300
TL22312CA E4	TL22312CA KE4	60	130	46	2.1	246	288	25 100
TL22313EAE4	TL22313EAKE4	65	140	48	2.1	375	380	38 000
TL22314EAE4	TL22314EAKE4	70	150	51	2.1	425	435	43 500
TL22315CA E4	TL22215CA KE4	75	130	31	2.1	340	415	34 500
TL22316CA E4	TL22316CA KE4	80	170	58	2.1	390	480	39 500
TL22318EAE4	TL22318EAKE4	90	190	64	3	665	705	68 000
TL22319CA E4	TL22319CA KE4	95	200	67	3	525	675	53 500
TL22320EAE4	TL22320EAKE4	100	215	73	3	860	930	88 000
TL23022CDE4	TL23022CDKE4	110	170	45	2	293	465	29 900
TL23222CE4	TL23222CKE4		200	69.8	2.1	515	760	52 500
TL22322EAE4	TL22322EAKE4		240	80	3	1 030	1120	105 000
TL22324EAE4	TL22324EAKE4	120	260	86	3	1 190	1 320	122 000
TL22326CA E4	TL22326CA KE4	130	280	93	4	995	1 350	101 000
TL23028CDE4	TL23028CDKE4	140	210	53	2	420	715	43 000
TL22228CDE4	TL22228CDKE4		250	68	3	645	930	65 500
TL23228CE4	TL23228CKE4		250	88	3	835	1 300	85 000
TL23030CDE4	TL23030CDKE4	150	225	56	2.1	470	815	48 000
TL23030CA E4	TL23030CA KE4		225	56	2.1	470	815	48 000
TL23130CA E4	TL23130CA KE4		250	80	2.1	725	1 180	74 000
TL22230CDE4	TL22230CDKE4		270	73	3	765	1 120	78 000
TL22330CA E4	TL22330CA KE4		320	108	4	1 220	1 690	125 000
TL23032CDE4	TL23032CDKE4	160	240	60	2.1	540	955	55 000
TL22232CDE4	TL22232CDKE4		290	80	3	910	1 320	93 000
TL23232CE4	TL23232CKE4		290	104	3	1 100	1 770	112 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Bearing Nomenclature

Example



{kgf}	Abutment and Fillet Dimensions (mm)					Constant	Axial Load Factors			Mass (kg)
C_{or}	d_a		D_a		r_a	e	Y_2	Y_3	Y_0	
	min.	max.	max.	min.	max.					approx.
13 200	49	-	81	77	1,5	0,38	2,6	1,8	1,7	1
24 600	65	-	110	103	2	0,36	2,8	1,9	1,8	2,3
29 400	72	-	118	111	2	0,36	2,8	1,9	1,9	2,9
38500	77	84	128	119	2	0,33	3,0	2,0	2,0	3,5
44 000	82	91	138	129	2	0,33	3,0	2,0	2,0	4,3
42 000	87	-	148	134	2	0,35	2,9	2,0	1,9	3,6
48 500	92	-	158	145	2	0,35	2,9	2,0	1,9	6,2
72 000	104	115	176	163	2,5	0,33	3,1	2,1	2,0	8,6
68 500	109	-	186	172	2,5	0,35	2,9	1,9	1,9	9,9
94 500	114	130	201	184	2,5	0,33	3,0	2,0	2,0	12,7
47 500	120	124	160	153	2	0,24	4,2	2,8	2,8	3,76
77 500	122	130	188	170	2	0,34	3,0	2,0	1,9	9,54
115 000	124	145	226	206	2,5	0,30	3,1	2,1	2,0	17,6
134 000	134	157	246	222	2,5	0,32	3,1	2,1	2,0	22,2
137000	148	-	262	236	3	0,34	2,9	2,0	1,9	27,8
73 000	150	157	200	190	2	0,22	4,5	3,0	2,9	6,49
95 000	154	167	236	219	2,5	0,25	4,0	2,7	2,6	14,5
133 000	154	163	236	213	2,5	0,25	2,9	1,9	1,9	18,8
83 000	162	168	213	203	2	0,22	4,6	3,1	3,0	7,9
83 000	162	-	213	203	2	0,22	4,6	3,1	3,0	7,9
121 000	162	-	238	218	2	0,3	3,4	2,3	2,2	15,8
114 000	164	179	256	236	2,5	0,26	3,9	2,6	2,5	18,4
172 000	168	-	302	270	3	0,35	2,9	1,9	1,9	41,5
97 500	172	179	228	216	2	0,22	4,5	3,0	2,9	9,66
135 000	174	190	276	255	2,5	0,26	3,8	2,6	2,5	23,1
180 000	174	189	276	245	2,5	0,34	2,9	2,0	1,9	30,5

Remarks: The suffix E4 indicates that the bering has an oil groove and holes.

Spherical Roller Bearings | TL Series, *d* 170-320 mm

Bearing Numbers		Boundary dimensions (mm)				Basic load ratings (N) (KN)		{kgf}
Cylindrical Bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{or}	C_r
TL23934BCA E4	TL23934BCA KE4	170	230	45	2	350	660	35 500
TL23034CDE4	TL23034CDKE4		260	67	2,1	640	1 090	65 000
TL23134CA E4	TL23134CA KE4		280	88	2,1	940	1 570	96 000
TL22334CA E4	TL22334CA KE4		360	120	4	1 580	2 110	161 000
TL23036CDE4	TL23036CDKE4	180	280	74	2,1	750	1 270	76 000
TL23236CA E4	TL23236CA KE4		320	112	4	1 300	2 110	133 000
TL23038CA E4	TL23038CA KE4	190	290	75	2,1	775	1 350	79 000
TL23138CA E4	TL23138CA KE4		320	104	3	1 190	2 020	121 000
TL22238CA E4	TL22238CA KE4		340	92	4	1 140	1 730	116 000
TL23238CA E4	TL23238CA KE4		340	120	4	1 440	2 350	147 000
TL22338CA E4	TL22338CA KE4		400	132	5	1 890	2 590	193 000
TL23040CA E4	TL23040CA KE4	200	310	82	2,1	940	1 700	96 000
TL23140CA E4	TL23140CA KE4		340	112	3	1 360	2 330	139 000
TL22240CA E4	TL22240CA KE4		360	98	4	1 300	2 010	133 000
TL23240CA E4	TL23240CA KE4		360	128	4	1 660	2 750	169 000
TL23044CA E4	TL23044CA KE4	220	340	90	3	1 090	1 980	111 000
TL23144CA E4	TL23144CA KE4		370	120	4	1 570	2 710	160 000
TL22244CA E4	TL22244CA KE4		400	108	4	1 570	2 430	160 000
TL23244CA E4	TL23244CA KE4		400	144	4	2 520	3 400	257 000
TL22344CA E4	TL22344CA KE4		460	145	5	2 350	3 400	240 000
TL23948CA E4	TL23948CA KE4	240	320	60	2,1	635	1 300	65 000
TL23048CA E4	TL23048CA KE4		350	92	3	1 160	2 140	118 000
TL23148CA E4	TL23148CA KE4		400	128	4	1 790	3 100	182 000
TL22348CA E4	TL22348CA KE4		500	155	5	2 600	3 800	265 000
TL23952CA E4	TL23952CA KE4	250	350	75	2,1	930	1 870	95 000
TL23052CA E4	TL23052CA KE4		400	104	4	1 430	2 580	145 000
TL23152CA E4	TL23152CA KE4	260	440	144	4	2 160	3 750	221 000
TL23956CA E4	TL23956CA KE4	280	380	75	2,1	925	1 950	94 500
TL23056CA E4	TL23056CA KE4		420	106	4	1 540	2 950	157 000
TL23156CA E4	TL23156CA KE4		460	146	5	2 230	4 000	228 000
TL23256CA E4	TL23256CA KE4		500	176	5	2 880	4 900	294 000
TL23960CA E4	TL23960CA KE4	300	420	90	3	1 230	2 490	125 000
TL23060CA E4	TL23060CA KE4		460	118	4	1 920	3 700	196 000
TL23160CA E4	TL23160CA KE4		500	160	5	2 670	4 800	273 000
TL23260CA E4	TL23260CA KE4		540	192	5	3 400	5 900	350 000
TL23164CA E4	TL23164CA KE4	320	540	176	5	3 050	5 500	315 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

{kgf}	Abutment and Fillet Dimensions (mm)					Constant	Axial Load Factors			Mass (kg)
C_{or}	d_a		D_a		r_a	e	Y_2	Y_3	Y_0	
	min.	max.	max.	min.	max.					approx.
67 500	180	-	220	213	2	0,17	5,8	3,9	3,8	5,38
112 000	182	191	248	233	2	0,23	4,3	2,9	2,9	13
160 000	182	-	268	245	2	0,29	3,5	2,3	2,3	21
215 000	188	-	342	304	3	0,35	2,9	1,9	1,9	57,9
129 000	192	202	268	249	2	0,24	4,2	2,8	2,8	17,1
215 000	198	-	302	274	3	0,35	2,9	1,9	1,9	38,5
138 000	202	-	278	261	2	0,24	4,2	2,8	2,8	17,6
206 000	204	-	306	276	3,5	0,31	3,2	2,2	2,1	34
176 000	208	-	322	296	3	0,26	3,8	2,6	2,5	35,5
240 000	208	-	322	288	3	0,35	2,9	1,9	1,9	46,5
264 000	212	-	378	338	4	0,34	2,9	2,0	1,9	77,6
174 000	212	-	298	279	2	0,25	4,0	2,7	2,6	22,6
238 000	214	-	326	293	2,5	0,32	3,2	2,1	2,1	41,5
204 000	218	-	342	315	3	0,26	3,8	2,6	2,5	42,6
281 000	218	-	342	307	3	0,35	2,9	1,9	1,9	57
202 000	234	-	326	302	2,5	0,24	4,1	2,8	2,7	29,7
276 000	238	-	352	320	3	0,31	3,2	2,2	2,1	52
247 000	238	-	382	348	3	0,27	3,7	2,5	2,4	59
350 000	238	-	382	337	3	0,36	2,8	1,9	1,8	79,5
345 000	242	-	438	391	4	0,33	3,0	2,0	2,0	116
133 000	252	-	308	298	2	0,17	6,0	4,0	3,9	13,3
218 000	254	-	346	324	2,5	0,24	4,2	2,8	2,7	32,6
320 000	258	-	382	347	3	0,31	3,3	2,2	2,2	64,5
385 000	262	-	478	423	4	0,32	3,2	2,1	2,1	147
191 000	272	-	348	333	2	0,19	5,4	3,6	3,5	23
263 000	278	-	382	356	3	0,25	4,1	2,7	2,7	46,6
385 000	278	-	422	380	3	0,32	3,2	2,1	2,1	88,2
199 000	292	-	368	351	2	0,18	5,7	3,9	3,8	24,5
300 000	298	-	402	377	3	0,24	4,2	2,8	2,7	50,5
410 000	302	-	438	400	4	0,3	3,3	2,2	2,2	94,3
500 000	302	-	478	425	4	0,35	2,9	1,9	1,9	147
254 000	314	-	406	386	2,5	0,19	5,2	3,5	3,4	38,2
375 000	318	-	442	413	3	0,24	4,2	2,8	2,7	70,5
490 000	322	-	478	433	4	0,31	3,3	2,2	2,2	125
600 000	322	-	518	458	4	0,35	2,9	1,9	1,9	189
560 000	342	-	518	466	4	0,31	3,2	2,1	2,1	162

Remarks: The suffix E4 indicates that the bering has an oil groove and holes.

Spherical Roller Bearings | TL Series, *d* 360-630 mm

Bearing Numbers		Boundary dimensions (mm)				Basic load ratings (N) (KN)		{kgf}
Cylindrical Bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{or}	C_r
TL23068CA E4	TL23068CA KE4	340	520	133	5	2 280	4 400	232 000
TL23168CA E4	TL23168CA KE4		580	190	5	3 600	6 600	370 000
TL23072CA E4	TL23072CA KE4	360	540	134	4	2 390	4 700	244 000
TL23976CA E4	TL23976CA KE4	380	520	106	4	1 870	4 100	190 000
TL23080CA E4	TL23080CA KE4	400	600	148	5	2 970	5 900	305 000
TL23984CA E4	TL23984CA KE4	420	560	106	4	1 870	4 250	191 000
TL23088CA E4	TL23088CA KE4	440	650	157	6	3 150	6 350	320 000
TL23992CA E4	TL23992CA KE4	460	620	118	4	2 220	4 950	227 000
TL239/500CA E4	TL239/500CA KE4	500	670	128	5	2 460	5 550	250 000
TL230/500CA E4	TL230/500CA KE4	500	720	167	6	3 750	8 100	385 000
TL231/500CA E4	TL231/500CA KE4	500	830	264	7,5	6 850	13 400	700 000
TL232/500CA E4	TL232/500CA KE4	500	920	336	7,5	9 000	16 600	915 000
TL240/500CA E4	TL240/500CA KE4	500	720	218	6	4 450	9 900	450 000
TL241/500CA E4	TL241/500CA KE4	500	830	325	7,5	8 000	16 000	815 000
TL239/530CA E4	TL239/530CA KE4	530	710	136	5	2 930	6 800	299 000
TL230/530CA E4	TL230/530CA KE4	530	780	185	6	4 400	9 200	450 000
TL231/530CA E4	TL231/530CA KE4	530	870	272	7,5	7 150	14 100	730 000
TL232/530CA E4	TL232/530CA KE4	530	980	355	9,5	10 100	18 800	1 030 000
TL240/530CA E4	TL240/530CA KE4	530	780	250	6	5 400	11 800	550 000
TL241/530CA E4	TL241/530CA KE4	530	870	335	7,5	8 500	17 500	870 000
TL239/560CA E4	TL239/560CA KE4	560	750	140	5	3 100	7 250	320 000
TL230/560CA E4	TL230/560CA KE4	560	820	195	6	5 000	10 700	510 000
TL231/560CA E4	TL231/560CA KE4	560	920	280	7,5	7 850	15 500	800 000
TL232/560CA E4	TL232/560CA KE4	560	1 030	365	9,5	10 900	20 500	1 110 000
TL240/560CA E4	TL240/560CA KE4	560	820	258	6	5 950	13 300	605 000
TL241/560CA E4	TL241/560CA KE4	560	920	355	7,5	9 400	19 600	960 000
TL239/600CA E4	TL239/600CA KE4	600	800	150	5	3 450	8 100	350 000
TL230/600CA E4	TL230/600CA KE4	600	870	200	6	5 450	12 200	555 000
TL231/600CA E4	TL231/600CA KE4	600	980	300	7,5	8 750	17 500	895 000
TL232/600CA E4	TL232/600CA KE4	600	1 090	388	9,5	12 700	24 900	1 300 000
TL240/600CA E4	TL240/600CA KE4	600	870	272	6	6 600	15 100	675 000
TL241/600CA E4	TL241/600CA KE4	600	980	375	7,5	10 400	21 900	1 060 000
TL239/630CA E4	TL239/630CA KE4	630	850	165	6	4 000	9 350	405 000
TL230/630CA E4	TL230/630CA KE4	630	920	212	7,5	5 900	12 700	600 000
TL231/630CA E4	TL231/630CA KE4	630	1 030	315	7,5	9 600	19 400	980 000
TL241/630CA E4	TL241/630CA KE4	630	1 030	400	7,5	11 300	23 900	1 160 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

{kgf} C_{or}	Abutment and Fillet Dimensions (mm) d_a min.	d_a max.	D_a max.	D_a min.	r_a max.	Constant e	Axial Load Factors Y_2	Y_3	Y_0	Mass (kg) approx.
445 000	362	-	458	465	4	0,24	4,2	2,8	2,8	101
670 000	362	-	558	499	4	0,31	3,2	2,1	2,1	206
480 000	382	-	518	485	4	0,24	4,2	2,8	2,8	106
420 000	398	-	502	482	3	0,18	5,5	3,7	3,6	65,4
605 000	422	-	578	540	4	0,23	4,4	3,0	2,9	146
430 000	438	-	542	521	3	0,17	6,0	4,0	3,9	71,6
645 000	468	-	622	587	5	0,23	4,3	2,9	2,8	173
505 000	478	-	602	573	3	0,17	5,9	4,0	3,9	100
565 000	522	-	648	622	4	0,17	6,0	4,0	3,9	124
825 000	528	-	692	655	5	0,21	4,8	3,2	3,1	220
1 360 000	536	-	794	720	6	0,31	3,2	2,2	2,1	567
1 690 000	536	-	884	773	6	0,38	2,7	1,8	1,8	969
1 010 000	528	-	692	643	5	0,30	3,4	2,3	2,2	276
1 630 000	536	-	794	703	6	0,39	2,6	1,7	1,7	666
695 000	552	-	688	659	4	0,17	6,0	4,0	3,9	149
940 000	558	-	752	706	5	0,22	4,6	3,1	3,0	298
1 440 000	566	-	834	758	6	0,30	3,3	2,2	2,2	628
1 920 000	574	-	936	824	8	0,38	2,7	1,8	1,7	1 170
1 210 000	558	-	752	690	5	0,31	3,3	2,2	2,2	390
1 790 000	566	-	834	740	6	0,38	2,6	1,8	1,7	773
740 000	582	-	728	697	4	0,16	6,1	4,1	4,0	172
1 090 000	588	-	792	742	5	0,22	4,5	3,0	2,9	344
1 580 000	596	-	884	804	6	0,3	3,4	2,3	2,2	727
2 090 000	604	-	986	870	8	0,36	2,8	1,9	1,8	1 320
1 360 000	588	-	792	729	5	0,3	3,3	2,2	2,2	440
2 000 000	596	-	884	782	6	0,39	2,6	1,8	1,7	886
830 000	622	-	778	745	4	0,17	5,9	3,9	3,9	205
1 240 000	628	-	842	794	5	0,21	4,8	3,3	3,2	389
1 790 000	636	-	944	856	6	0,3	3,4	2,3	2,2	898
2 540 000	644	-	1 046	923	8	0,36	2,8	1,9	1,8	1590
1 540 000	628	-	842	772	5	0,3	3,3	2,2	2,2	529
2 230 000	636	-	944	836	6	0,39	2,6	1,8	1,7	1 050
950 000	658	-	822	786	5	0,18	5,6	3,8	3,7	259
1 300 000	666	-	884	835	6	0,22	4,7	3,1	3,1	468
1 970 000	666	-	994	900	6	0,3	3,4	2,3	2,2	1 040
2 440 000	666	-	994	876	6	0,38	2,7	1,8	1,7	1 250

Remarks: The suffix E4 indicates that the bering has an oil groove and holes.

Spherical Roller Bearings | TL Series, *d* 670-1000 mm

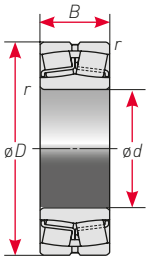
Bearing Numbers		Boundary dimensions (mm)				Basic load ratings (N) (KN)		{kgf}
Cylindrical Bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{or}	C_r
TL239/670CA E4	TL239/670CA KE4	670	900	170	6	4 350	10 300	445 000
TL230/670CA E4	TL230/670CA KE4	670	980	230	7,5	6 850	15 000	700 000
TL241/670CA E4	TL241/670CA KE4	670	1 090	412	7,5	12 400	26 500	1 270 000
TL239/710CA E4	TL239/710CA KE4	710	950	180	6	4 800	11 700	490 000
TL230/710CA E4	TL230/710CA KE4	710	1 030	236	7,5	7 100	15 800	725 000
TL241/710CA E4	TL241/710CA KE4	710	1 150	438	9,5	13 900	30 500	1 410 000
TL239/750CA E4	TL239/750CA KE4	750	1 000	185	6	5 250	12 800	535 000
TL230/750CA E4	TL230/750CA KE4	750	1 090	250	7,5	7 750	17 200	790 000
TL241/750CA E4	TL241/750CA KE4	750	1220	475	9,5	16 100	35 000	1 640 000
TL239/800CA E4	TL239/800CA KE4	800	1 060	195	6	5 600	13 700	570 000
TL230/800CA E4	TL230/800CA KE4	800	1 150	258	7,5	8 350	19 100	850 000
TL239/850CA E4	TL239/850CA KE4	850	1 120	200	6	6 100	15 200	620 000
TL230/850CA E4	TL230/850CA KE4	850	1 220	272	7,5	9 300	21 400	945 000
TL239/950CA E4	TL239/950CA KE4	950	1 250	224	7,5	7 600	19 900	775 000
TL230/950CA E4	TL230/950CA KE4	950	1 360	300	7,5	11 300	26 500	1 160 000
TL239/1000CA E4	TL239/1000CA KE4	1 000	1 320	236	7,5	8 200	21 700	83 500

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

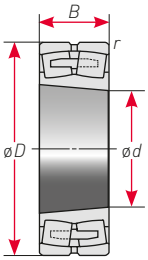
{kgf} C_{or}	Abutment and Fillet Dimensions (mm) d_a min.	d_a max.	D_a max.	D_a min.	r_a max.	Constant e	Axial Load Factors Y_2	Y_3	Y_0	Mass (kg) approx.
1 050 000	698	-	872	836	5	0,17	5,8	3,9	3,8	300
1 530 000	706	-	944	891	6	0,22	4,7	3,1	3,1	571
2 700 000	706	-	1 054	934	6	0,37	2,7	1,8	1,8	1 440
1 200 000	738	-	922	883	5	0,17	5,8	3,9	3,8	352
1 610 000	746	-	994	936	6	0,22	4,6	3,1	3,0	647
3 100 000	754	-	1 106	981	8	0,38	2,6	1,8	1,7	1 730
1 310 000	778	-	972	931	5	0,17	6,0	4,1	4,0	398
1 750 000	786	-	1 054	990	6	0,22	4,6	3,1	3,0	768
3 550 000	794	-	1176	1 038	8	0,22	2,6	1,8	1,7	798
1 400 000	828	-	1 032	987	5	0,17	6,0	4,0	3,9	462
1 950 000	836	-	1 114	1 045	6	0,21	4,7	3,2	3,1	870
1 550 000	878	-	1 092	1 046	5	0,16	6,2	4,2	4,1	523
2 190 000	886	-	1 184	1 109	6	0,21	4,8	3,2	3,1	1 020
2 030 000	986	-	1 214	1 169	6	0,16	6,3	4,2	4,1	732
2 710 000	986	-	1 324	1 241	6	0,21	4,8	3,2	3,2	1 400
2 210 000	1 036	-	1 284	1 229	6	0,16	6,4	4,3	4,2	881

Remarks: The suffix E4 indicates that the bering has an oil groove and holes.

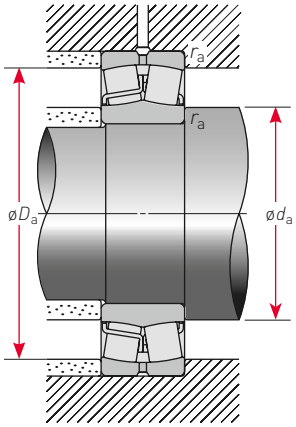
SPHERICAL ROLLER BEARINGS – NSKHPS



Cylindrical bore



Tapered bore



$F_a / F_r \leq e$		$F_a / F_r > e$	
X	Y	X	Y
1	Y_3	0,67	Y_2

Dynamic Equivalent Load
$P = XF_r + YF_a$

Static Equivalent Load
$P_0 = F_r + Y_0F_a$

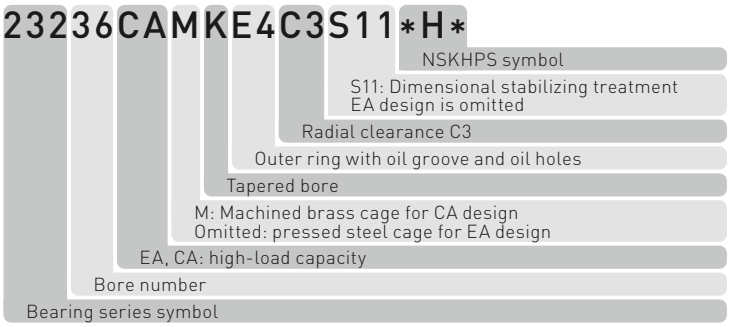
The values of e, Y_2, Y_3 and Y_0 are given in the table below.

Bearing numbers		Boundary dimensions (mm)				Basic load ratings (N)	
Cylindrical bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{0r}
22208EAE4	22208EAKE4	40	80	23	1.1	113 000	99 500
21308EAE4	21308EAKE4		90	23	1.5	118 000	111 000
22308EAE4	22308EAKE4		90	33	1.5	170 000	153 000
22209EAE4	22209EAKE4	45	85	23	1.1	118 000	111 000
21309EAE4	21309EAKE4		100	25	1.5	149 000	144 000
22309EAE4	22309EAKE4		100	36	1.5	207 000	195 000
22210EAE4	22210EAKE4	50	90	23	1.1	124 000	119 000
21310EAE4	21310EAKE4		110	27	2	178 000	175 000
22310EAE4	22310EAKE4		110	40	2	246 000	234 000
22211EAE4	22211EAKE4	55	100	25	1.5	149 000	144 000
21311EAE4	21311EAKE4		120	29	2	178 000	174 000
22311EAE4	22311EAKE4		120	43	2	292 000	292 000
22212EAE4	22212EAKE4	60	110	28	1.5	178 000	174 000
21312EAE4	21312EAKE4		130	31	2.1	238 000	244 000
22312EAE4	22312EAKE4		130	46	2.1	340 000	340 000
22213EAE4	22213EAKE4	65	120	31	1.5	221 000	230 000
21313EAE4	21313EAKE4		140	33	2.1	264 000	275 000
22313EAE4	22313EAKE4		140	48	2.1	375 000	380 000
22214EAE4	22214EAKE4	70	125	31	1.5	225 000	232 000
21314EAE4	21314EAKE4		150	35	2.1	310 000	325 000
22314EAE4	22314EAKE4		150	51	2.1	425 000	435 000
22215EAE4	22215EAKE4	75	130	31	1.5	238 000	244 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Bearing Nomenclature

Example



Limiting speeds (min.$^{-1}$)		Abutment and fillet dimensions (mm)					Constant	Axial load factors		
Grease	Oil	d_a		D_a		r_a	e	Y_2	Y_3	Y_0
		min.	max.	max.	min.	max.				
6 700	8 500	47	49	73	70	1	0.28	3.6	2.4	2.4
6 000	7 500	49	54	81	75	1.5	0.25	3.9	2.7	2.6
5 300	6 700	49	52	81	77	1.5	0.35	2.8	1.9	1.9
6 000	7 500	52	54	78	75	1	0.25	3.9	2.7	2.6
5 000	6 300	54	65	91	89	1.5	0.23	4.3	2.9	2.8
4 500	5 600	54	59	91	86	1.5	0.34	2.9	2.0	1.9
5 600	7 100	57	60	83	81	1	0.24	4.3	2.9	2.8
4 500	5 600	60	72	100	98	2	0.23	4.4	3.0	2.9
4 300	5 300	60	64	100	93	2	0.35	2.8	1.9	1.9
5 300	6 700	64	65	91	89	1.5	0.23	4.3	2.9	2.8
4 500	5 600	65	72	110	98	2	0.23	4.4	3.0	2.9
3 800	4 800	65	73	110	103	2	0.34	2.9	2.0	1.9
4 800	6 000	69	72	101	98	1.5	0.23	4.4	3.0	2.9
3 800	4 800	72	87	118	117	2	0.22	4.5	3.0	3.0
3 600	4 500	72	79	118	111	2	0.34	3.0	2.0	1.9
4 300	5 300	74	80	111	107	1.5	0.24	4.2	2.8	2.7
3 600	4 500	77	94	128	126	2	0.22	4.6	3.1	3.0
3 200	4 000	77	84	128	119	2	0.33	3.0	2.0	2.0
4 000	5 300	79	84	116	111	1.5	0.23	4.3	2.9	2.8
3 200	4 000	82	101	138	135	2	0.22	4.6	3.1	3.0
3 000	3 800	82	91	138	129	2	0.33	3.0	2.0	2.0
4 000	5 000	84	87	121	117	1.5	0.22	4.5	3.0	3.0

Remarks: 1. The maximum operating temperature of standard NSKHPS spherical roller bearings is 200°C.
2. The suffix E4 indicates that the bearing has an oil groove and holes.

Spherical Roller Bearings | NSKHPS, *d* 80-130 mm

Bearing numbers		Boundary dimensions (mm)				Basic load ratings (N)	
Cylindrical bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{0r}
21315EAE4	21315EAKE4		160	37	2.1	310 000	325 000
22315EAE4	22315EAKE4		160	55	2.1	485 000	505 000
22216EAE4	22216EAKE4	80	140	33	2	264 000	275 000
21316EAE4	21316EAKE4		170	39	2.1	355 000	375 000
22316EAE4	22316EAKE4		170	58	2.1	540 000	565 000
22217EAE4	22217EAKE4	85	150	36	2	310 000	325 000
21317EAE4	21317EAKE4		180	41	3	360 000	395 000
22317EAE4	22317EAKE4		180	60	3	600 000	630 000
22218EAE4	22218EAKE4	90	160	40	2	360 000	395 000
21318EAE4	21318EAKE4		190	43	3	415 000	450 000
22318EAE4	22318EAKE4		190	64	3	665 000	705 000
22219EAE4	22219EAKE4	95	170	43	2.1	415 000	450 000
21319CAME4	21319CAMKE4		200	45	3	430 000	435 000
22319EAE4	22319EAKE4		200	67	3	735 000	780 000
22220EAE4	22220EAKE4	100	180	46	2.1	455 000	490 000
23220CAME4	23220CAMKE4		180	60.3	2.1	525 000	605 000
21320CAME4	21320CAMKE4		215	47	3	495 000	485 000
22320EAE4	22320EAKE4		215	73	3	860 000	930 000
23122CAME4	23122CAMKE4	110	180	56	2	480 000	630 000
24122CAME4	24122CAMKE4		180	69	2	575 000	750 000
22222EAE4	22222EAKE4		200	53	2.1	605 000	645 000
23222CAME4	23222CAMKE4		200	69.8	2.1	645 000	760 000
21322CAME4	21322CAMKE4		240	50	3	565 000	545 000
22322EAE4	22322EAKE4		240	80	3	1 030 000	1 120 000
23024CAME4	23024CAMKE4	120	180	46	2	395 000	525 000
24024CAME4	24024CAMKE4		180	60	2	480 000	680 000
23124CAME4	23124CAMKE4		200	62	2	580 000	720 000
24124CAME4	24124CAMKE4		200	80	2	695000	905000
22224EAE4	22224EAKE4		215	58	2.1	685 000	765 000
23224CAME4	23224CAMKE4		215	76	2.1	790 000	970 000
22324EAE4	22324EAKE4		260	86	3	1 190 000	1 320 000
23026CAME4	23026CAMKE4	130	200	52	2	500 000	655 000
24026CAME4	24026CAMKE4		200	69	2	620 000	865 000
23126CAME4	23126CAMKE4		210	64	2	630 000	825 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Limiting speeds (min.$^{-1}$)		Abutment and fillet dimensions (mm)					Constant	Axial load factors		
Grease	Oil	d_a		D_a		r_a	e	Y_2	Y_3	Y_0
		min.	max.	max.	min.	max.				
3 200	4 000	87	101	148	134	2	0.22	4.6	3.1	3.0
2 800	3 600	87	97	148	137	2	0.33	3.0	2.0	2.0
3 600	4 500	90	94	130	126	2	0.22	4.6	3.1	3.0
3 000	3 800	92	109	158	146	2	0.23	4.4	3.0	2.9
2 600	3 400	92	103	158	145	2	0.33	3.0	2.0	2.0
3 400	4 300	95	101	140	135	2	0.22	4.6	3.1	3.0
3 000	4 000	99	108	166	142	2.5	0.24	4.3	2.9	2.8
2 400	3 200	99	110	166	155	2.5	0.33	3.1	2.1	2.0
3 200	4 000	100	108	150	142	2	0.24	4.3	2.9	2.8
2 800	3 600	104	115	176	152	2.5	0.24	4.3	2.9	2.8
2 400	3 000	104	115	176	163	2.5	0.33	3.1	2.1	2.0
3 000	3 800	107	115	158	152	2	0.24	4.3	2.9	2.8
1 500	2 000	109	127	186	172	2.5	0.22	4.6	3.1	3.0
2 200	2 800	109	121	186	172	2.5	0.33	3.1	2.1	2.0
2 800	3 600	112	119	168	160	2	0.24	4.3	2.9	2.8
1 600	2 200	112	118	168	155	2	0.32	3.2	2.1	2.1
1 400	1 900	114	133	201	184	2.5	0.23	4.4	3.0	2.9
2 000	2 600	114	130	201	184	2.5	0.33	3.0	2.0	2.0
1 600	2 000	120	127	170	158	2	0.28	3.5	2.4	2.3
1 600	2 000	120	123	170	154	2	0.36	2.8	1.9	1.8
2 600	3 200	122	129	188	178	2	0.25	4.0	2.7	2.6
1 500	1 900	122	130	188	170	2	0.34	3.0	2.0	1.9
1 300	1 700	124	-	226	206	2.5	0.22	4.6	3.1	3.0
1 900	2 400	124	145	226	206	2.5	0.33	3.1	2.1	2.0
1 800	2 200	130	134	170	163	2	0.22	4.5	3.0	2.9
1 500	2 000	130	131	170	158	2	0.32	3.2	2.1	2.1
1 400	1 800	130	138	190	175	2	0.29	3.5	2.4	2.3
1 400	1 800	130	136	190	171	2	0.37	2.7	1.8	1.8
2 400	3 000	132	142	203	190	2	0.25	3.9	2.7	2.6
1 300	1 700	132	140	203	182	2	0.34	2.9	2.0	1.9
1 700	2 200	134	157	246	222	2.5	0.32	3.1	2.1	2.0
1 700	2 000	140	147	190	180	2	0.23	4.3	2.9	2.8
1 400	1 800	140	143	190	175	2	0.31	3.2	2.2	2.1
1 300	1 700	140	149	200	184	2	0.28	3.6	2.4	2.4

Remarks: 1. The maximum operating temperature of standard NSKHPS spherical roller bearings is 200°C.
2. The suffix E4 indicates that the bearing has an oil groove and holes.

Bearing numbers		Boundary dimensions (mm)				Basic load ratings (N)	
Cylindrical bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{0r}
24126CAME4	24126CAMKE4		210	80	2	735 000	1 010 000
22226EAE4	22226EAKE4		230	64	3	820 000	940 000
23226CAME4	23226CAMKE4		230	80	3	875 000	1 080 000
22326CAME4	22326CAMKE4		280	93	4	1 240 000	1 350 000
23128CAME4	23128CAMKE4		225	68	2.1	725 000	945 000
24128CAME4	24128CAMKE4		225	85	2.1	835 000	1 160 000
22228CAME4	22228CAMKE4		250	68	3	835 000	945 000
23228CAME4	23228CAMKE4		250	88	3	1 040 000	1 300 000
22328CAME4	22328CAMKE4		300	102	4	1 450 000	1 590 000
23030CAME4	23030CAMKE4	150	225	56	2.1	590 000	815 000
24030CAME4	24030CAMKE4		225	75	2.1	740 000	1 090 000
23130CAME4	23130CAMKE4		250	80	2.1	905 000	1 180 000
24130CAME4	24130CAMKE4		250	100	2.1	1 070 000	1 450 000
22230CAME4	22230CAMKE4		270	73	3	955 000	1 120 000
23230CAME4	23230CAMKE4		270	96	3	1 220 000	1 560 000
22330CAME4	22330CAMKE4		320	108	4	1 530 000	1 690 000
23932CAME4	23932CAMKE4	160	220	45	2	450 000	675 000
23032CAME4	23032CAMKE4		240	60	2.1	675 000	955 000
24032CAME4	24032CAMKE4		240	80	2.1	845 000	1 260 000
23132CAME4	23132CAMKE4		270	86	2.1	1 070 000	1 400 000
24132CAME4	24132CAMKE4		270	109	2.1	1 240 000	1 670 000
22232CAME4	22232CAMKE4		290	80	3	1 140 000	1 320 000
23232CAME4	23232CAMKE4		290	104	3	1 370 000	1 770 000
22332CAME4	22332CAMKE4		340	114	4	1 700 000	1 900 000
23934BCAME4	23934BCAMKE4	170	230	45	2	440 000	660 000
23034CAME4	23034CAMKE4		260	67	2.1	795 000	1 090 000
24034CAME4	24034CAMKE4		260	90	2.1	1 030 000	1 520 000
23134CAME4	23134CAMKE4		280	88	2.1	1 180 000	1 570 000
24134CAME4	24134CAMKE4		280	109	2.1	1 280 000	1 770 000
22234CAME4	22234CAMKE4		310	86	4	1 240 000	1 500 000
23234CAME4	23234CAMKE4		310	110	4	1 500 000	1 910 000
22334CAME4	22334CAMKE4		360	120	4	1 970 000	2 110 000
23936CAME4	23936CAMKE4	180	250	52	2	590 000	890 000
23036CAME4	23036CAMKE4		280	74	2.1	935 000	1 270 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Limiting speeds (min.$^{-1}$)		Abutment and fillet dimensions (mm)					Constant	Axial load factors		
Grease	Oil	d_a		D_a		r_a	e	Y_2	Y_3	Y_0
		min.	max.	max.	min.	max.				
1 300	1 700	140	146	200	180	2	0.37	2.7	1.8	1.8
2 200	2 600	144	152	216	204	2.5	0.26	3.8	2.6	2.5
1 200	1 600	144	150	216	196	2.5	0.34	2.9	2.0	1.9
1 300	1 600	148	166	262	236	3	0.34	2.9	2.0	1.9
1 200	1 600	152	158	213	198	2	0.28	3.6	2.4	2.3
1 200	1 600	152	156	213	192	2	0.37	2.7	1.8	1.8
1 400	1 700	154	167	236	221	2.5	0.26	3.9	2.6	2.5
1 100	1 500	154	163	236	213	2.5	0.35	2.9	1.9	1.9
1 200	1 500	158	177	282	253	3	0.35	2.9	1.9	1.9
1 400	1 800	162	168	213	203	2	0.22	4.6	3.1	3.0
1 200	1 500	162	165	213	198	2	0.30	3.4	2.3	2.2
1 100	1 400	162	174	238	218	2	0.30	3.4	2.3	2.2
1 100	1 400	162	169	238	212	2	0.38	2.6	1.8	1.7
1 300	1 600	164	179	256	236	2.5	0.26	3.9	2.6	2.5
1 100	1 400	164	176	256	230	2.5	0.35	2.9	1.9	1.9
1 100	1 400	168	-	302	270	3	0.35	2.9	1.9	1.9
1 400	1 800	170	-	210	203	2	0.18	5.6	3.8	3.7
1 300	1 700	172	179	228	216	2	0.22	4.5	3.0	2.9
1 100	1 400	172	177	228	212	2	0.30	3.4	2.3	2.2
1 000	1 300	172	185	258	234	2	0.30	3.4	2.3	2.2
1 000	1 300	172	179	258	229	2	0.39	2.6	1.7	1.7
1 200	1 500	174	190	276	255	2.5	0.26	3.8	2.6	2.5
1 000	1 300	174	189	276	245	2.5	0.34	2.9	2.0	1.9
1 100	1 300	178	-	322	287	3	0.35	2.9	1.9	1.9
1 400	1 800	180	-	220	213	2	0.17	5.8	3.9	3.8
1 200	1 600	182	191	248	233	2	0.23	4.3	2.9	2.8
1 000	1 300	182	188	248	228	2	0.31	3.2	2.2	2.1
1 000	1 300	182	194	268	245	2	0.29	3.5	2.3	2.3
1 000	1 300	182	190	268	239	2	0.38	2.7	1.8	1.7
1 100	1 400	188	206	292	270	3	0.26	3.8	2.6	2.5
900	1 200	188	201	292	261	3	0.35	2.9	1.9	1.9
1 000	1 200	188	-	342	304	3	0.35	2.9	1.9	1.9
1 200	1 600	190	-	240	230	2	0.18	5.5	3.7	3.6
1 200	1 400	192	202	268	249	2	0.24	4.2	2.8	2.8

Remarks: 1. The maximum operating temperature of standard NSKHPS spherical roller bearings is 200°C.
2. The suffix E4 indicates that the bearing has an oil groove and holes.

Bearing numbers		Boundary dimensions (mm)				Basic load ratings (N)	
Cylindrical bore	Tapered bore [1]	*d*	*D*	*B*	*r* min.	C_r	C_{0r}
24036CAME4	24036CAMKE4		280	100	2.1	1 210 000	1 750 000
23136CAME4	23136CAMKE4		300	96	3	1 320 000	1 760 000
24136CAME4	24136CAMKE4		300	118	3	1 490 000	2 040 000
22236CAME4	22236CAMKE4		320	86	4	1 280 000	1 540 000
23236CAME4	23236CAMKE4		320	112	4	1 620 000	2 110 000
22336CAME4	22336CAMKE4		380	126	4	2 170 000	2 340 000
23938CAME4	23938CAMKE4	190	260	52	2	575 000	875 000
23038CAME4	23038CAMKE4		290	75	2.1	970 000	1 350 000
24038CAME4	24038CAMKE4		290	100	2.1	1 220 000	1 840 000
23138CAME4	23138CAMKE4		320	104	3	1 480 000	2 020 000
24138CAME4	24138CAMKE4		320	128	3	1 630 000	2 240 000
22238CAME4	22238CAMKE4		340	92	4	1 420 000	1 730 000
23238CAME4	23238CAMKE4		340	120	4	1 800 000	2 350 000
22338CAME4	22338CAMKE4		400	132	5	2 370 000	2 590 000
23940CAME4	23940CAMKE4	200	280	60	2.1	710 000	1 060 000
23040CAME4	23040CAMKE4		310	82	2.1	1 180 000	1 700 000
24040CAME4	24040CAMKE4		310	109	2.1	1 420 000	2 120 000
23140CAME4	23140CAMKE4		340	112	3	1 700 000	2 330 000
24140CAME4	24140CAMKE4		340	140	3	1 960 000	2 660 000
22240CAME4	22240CAMKE4		360	98	4	1 620 000	2 010 000
23240CAME4	23240CAMKE4		360	128	4	2 070 000	2 750 000
23944CAME4	23944CAMKE4	220	300	60	2.1	785 000	1 240 000
23044CAME4	23044CAMKE4		340	90	3	1 360 000	1 980 000
24044CAME4	24044CAMKE4		340	118	3	1 640 000	2 490 000
23144CAME4	23144CAMKE4		370	120	4	1 960 000	2 710 000
24144CAME4	24144CAMKE4		370	150	4	2 250 000	3 200 000
22244CAME4	22244CAMKE4		400	108	4	1 960 000	2 430 000
23244CAME4	23244CAMKE4		400	144	4	2 520 000	3 400 000
23948CAME4	23948CAMKE4	240	320	60	2.1	795 000	1 300 000
23048CAME4	23048CAMKE4		360	92	3	1 450 000	2 140 000
24048CAME4	24048CAMKE4		360	118	3	1 730 000	2 730 000
23148CAME4	23148CAMKE4		400	128	4	2 230 000	3 100 000
24148CAME4	24148CAMKE4		400	160	4	2 660 000	3 800 000
23952CAME4	23952CAMKE4	260	360	75	2.1	1 170 000	1 870 000

Note (1): The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Limiting speeds (min.$^{-1}$)		Abutment and fillet dimensions (mm)					Constant	Axial load factors		
Grease	Oil	d_a		D_a		r_a	e	Y_2	Y_3	Y_0
		min.	max.	max.	min.	max.				
950	1 200	192	200	268	245	2	0.32	3.1	2.1	2.0
900	1 200	194	206	286	260	2.5	0.31	3.3	2.2	2.2
900	1 200	194	202	286	255	2.5	0.37	2.7	1.8	1.8
1 100	1 300	198	212	302	278	3	0.26	3.9	2.6	2.6
850	1 100	198	211	302	274	3	0.35	2.9	1.9	1.9
950	1 200	198	-	362	322	3	0.34	2.9	2.0	1.9
1 200	1 500	200	-	250	240	2	0.18	5.7	3.8	3.7
1 100	1 400	202	-	278	261	2	0.24	4.2	2.8	2.8
900	1 200	202	210	278	253	2	0.32	3.1	2.1	2.0
850	1 100	204	219	306	276	2.5	0.31	3.2	2.2	2.1
850	1 100	204	211	306	269	2.5	0.38	2.6	1.8	1.7
1 000	1 200	208	-	322	296	3	0.26	3.8	2.6	2.5
800	1 100	208	222	322	288	3	0.35	2.8	1.9	1.9
900	1 100	212	-	378	338	4	0.34	2.9	2.0	1.9
1 100	1 400	212	-	268	258	2	0.20	5.1	3.4	3.3
1 000	1 300	212	-	298	279	2	0.25	4.0	2.7	2.6
850	1 100	212	223	298	271	2	0.33	3.0	2.0	2.0
800	1 000	214	232	326	293	2.5	0.32	3.2	2.1	2.1
800	1 000	214	226	326	290	2.5	0.39	2.5	1.7	1.7
950	1 200	218	-	342	315	3	0.26	3.8	2.6	2.5
750	1 000	218	237	342	307	3	0.35	2.9	1.9	1.9
1 000	1 300	232	-	288	278	2	0.18	5.7	3.8	3.7
950	1 200	234	-	326	302	2.5	0.24	4.1	2.8	2.7
750	1 000	234	244	326	296	2.5	0.32	3.2	2.1	2.1
710	950	238	254	352	320	3	0.31	3.2	2.1	2.1
710	950	238	248	352	313	3	0.39	2.6	1.7	1.7
850	1 000	238	260	382	348	3	0.27	3.7	2.5	2.4
670	900	238	-	382	337	3	0.36	2.8	1.9	1.8
950	1 200	252	-	308	298	2	0.17	6.0	4.0	3.9
850	1 100	254	-	346	324	2.5	0.24	4.2	2.8	2.7
710	950	254	265	346	317	2.5	0.30	3.3	2.2	2.2
670	850	258	275	382	347	3	0.31	3.3	2.2	2.2
670	850	258	268	382	341	3	0.38	2.7	1.8	1.8
850	1 000	272	-	348	333	2	0.19	5.4	3.6	3.5

Remarks: 1. The maximum operating temperature of standard NSKHPS spherical roller bearings is 200°C.
2. The suffix E4 indicates that the bearing has an oil groove and holes.

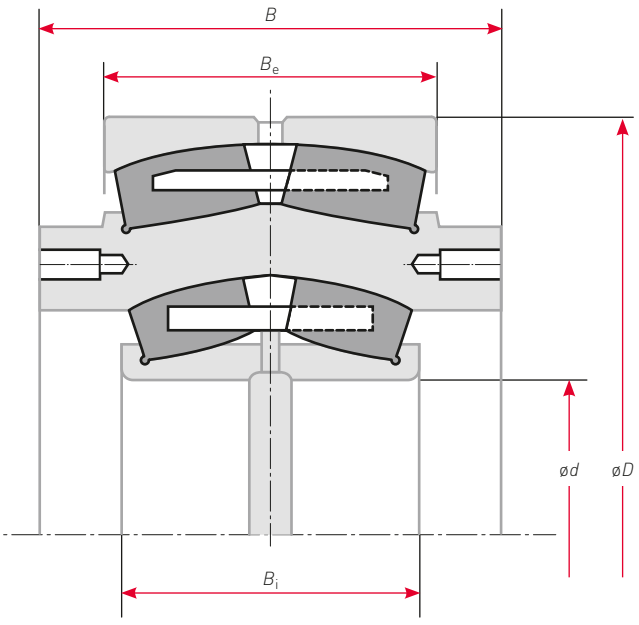
TRIPLE RING BEARINGS

Bearing Nomenclature

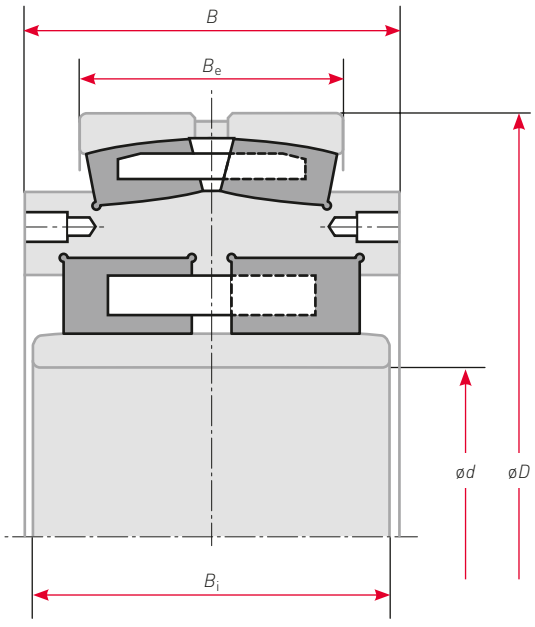
Example **2SL180-2UPA**

- 2SL — Triple ring bearings
- 180 — Bearing bore 180 mm
- 2UPA — Special accuracy

Bearing numbers	Boundary dimensions (mm)					Mass (kg)
	d	*D*	B_i	B_e	*B*	
2SL180-2 UPA	180	480	140	160	215.9	175
2SL200-2 UPA	200	520	160	180	241.3	230
2SL220-2 UPA	220	600	180	200	279.4	330
2SL240-2 UPA	240	620	200	200	279.4	410
2SL260-2 UPA	260	680	218	218	317.5	490
2SL280-2 UPA	280	720	218	218	317.5	525
2SL300-2 UPA	300	780	243	250	342.9	735
2SL320-2 UPA	320	820	258	258	368.3	840
2SL340-2 UPA	340	870	280	272	393.7	1 050
2SL380-3 UPA	380	980	240	308	431.8	1 370
2PSL180-1 UPA	180	460	153	118	160	127
2PSL240-1 UPA	240	600	205	160	225	285



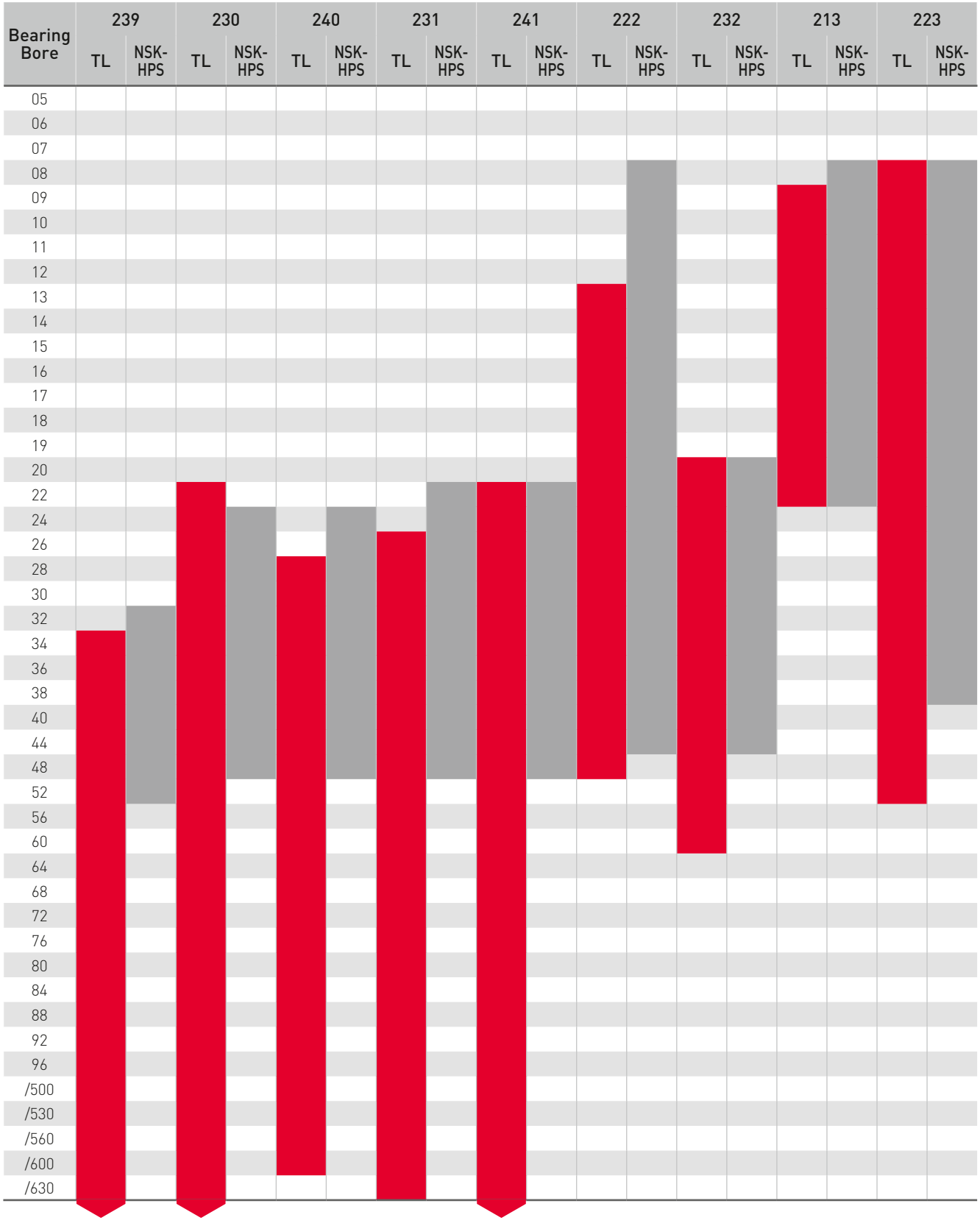
2SL



2PSL

SPHERICAL ROLLER BEARINGS

TL Bearings
NSKHPS



Other sizes on request.

RADIAL CLEARANCE IN SPHERICAL ROLLER BEARINGS WITH TAPERED BORES

Bearings with tapered bores are directly mounted onto tapered shafts or cylindrical shafts with adapters or withdrawal sleeves (Fig. 1).
Large bearings are often mounted using hydraulic pressure. Fig. 2 shows a bearing mounting utilising a sleeve and hydraulic nut. Another mounting method is to drill holes in the sleeve which are used to feed oil under pressure to seat the bearing. As the bearing expands radially, the sleeve is inserted axially with adjusting bolts.
The bearing should be mounted with a suitable interference fit by checking residual clearance while measuring their radial-clearance reduction and referring to the amount of axial movement listed in Table 1. Radial clearance must be measured using clearance gauges. As shown in Fig. 3, radial clearance for both rows of rollers must be measured simultaneously, and those two values should be kept roughly the same. When a large bearing is mounted on a shaft, the outer ring may be deformed into an oval shape by its own weight. If radial clearance is measured at the lowest part of the deformed bearing, the measured value may be greater than the true value. If an incorrect radial internal clearance is obtained in this manner and the value in Table 1 are used, then the interference fit may become too tight and the true residual clearance may become too small. In this case, as shown in Fig. 4, one half of the total clearance at points a and b (which are on a horizontal line passing through the bearing center) and c (which is the lowest position of the bearing) may be used as the residual clearance.

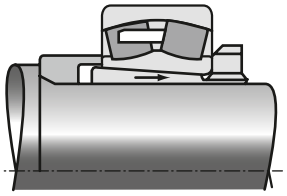


Fig. 1 Mounting with adapter

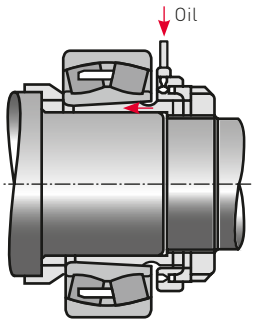


Fig. 2 Mounting with hydraulic nut

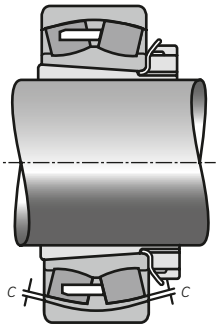


Fig. 3 Clearance measurement of spherical roller bearing

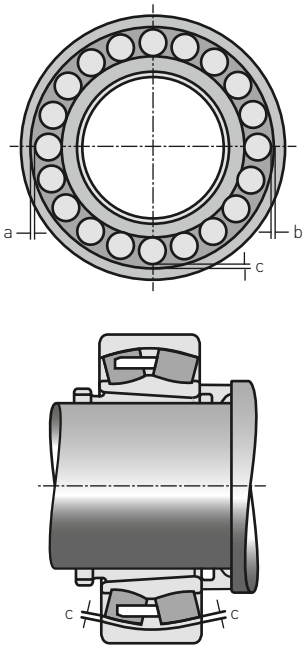


Fig. 4 Measuring clearance in large spherical roller bearing

Radial Clearance in Spherical Roller Bearings with Tapered Bores

Bearing bore		Clearance in bearings with tapered bores						Reduction in radial clearance		Axial movement				Minimum permissible residual clearance		
d		CN		C3		C4				Taper 1:12		Taper 1:30		CN	C3	C4
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.			
30	40	0.035	0.050	0.050	0.065	0.065	0.085	0.025	0.030	0.40	0.45	-	-	0.010	0.025	0.035
40	50	0.045	0.060	0.060	0.080	0.080	0.100	0.030	0.035	0.45	0.55	-	-	0.015	0.030	0.045
50	65	0.055	0.075	0.075	0.095	0.095	0.120	0.030	0.035	0.45	0.55	-	-	0.025	0.035	0.060
65	80	0.070	0.095	0.095	0.120	0.120	0.150	0.040	0.045	0.60	0.70	-	-	0.030	0.040	0.075
80	100	0.080	0.110	0.110	0.140	0.140	0.180	0.045	0.055	0.70	0.85	1.75	2.15	0.035	0.050	0.085
100	120	0.100	0.135	0.135	0.170	0.170	0.220	0.050	0.060	0.75	0.90	1.9	2.25	0.045	0.065	0.110
120	140	0.120	0.160	0.160	0.200	0.200	0.260	0.060	0.070	0.90	1.1	2.25	2.75	0.055	0.080	0.130
140	160	0.130	0.180	0.180	0.230	0.230	0.300	0.065	0.080	1.0	1.3	2.5	3.25	0.060	0.100	0.150
160	180	0.140	0.200	0.200	0.260	0.260	0.340	0.070	0.090	1.1	1.4	2.75	3.5	0.070	0.110	0.170
180	200	0.160	0.220	0.220	0.290	0.290	0.370	0.080	0.100	1.3	1.6	3.25	4.0	0.070	0.110	0.190
200	225	0.180	0.250	0.250	0.320	0.320	0.410	0.090	0.110	1.4	1.7	3.5	4.25	0.080	0.130	0.210
225	250	0.200	0.270	0.270	0.350	0.350	0.450	0.100	0.120	1.6	1.9	4.0	4.75	0.090	0.140	0.230
250	280	0.220	0.300	0.300	0.390	0.390	0.490	0.110	0.140	1.7	2.2	4.25	5.5	0.100	0.150	0.250
280	315	0.240	0.330	0.330	0.430	0.430	0.540	0.120	0.150	1.9	2.4	4.75	6.0	0.110	0.160	0.280
315	355	0.270	0.360	0.360	0.470	0.470	0.590	0.140	0.170	2.2	2.7	5.5	6.75	0.120	0.180	0.300
355	400	0.300	0.400	0.400	0.520	0.520	0.650	0.150	0.190	2.4	3.0	6.0	7.5	0.130	0.200	0.330
400	450	0.330	0.440	0.440	0.570	0.570	0.720	0.170	0.210	2.7	3.3	6.75	8.25	0.140	0.220	0.360
450	500	0.370	0.490	0.490	0.630	0.630	0.790	0.190	0.240	3.0	3.7	7.5	9.25	0.160	0.240	0.390
500	560	0.410	0.540	0.540	0.680	0.680	0.870	0.210	0.270	3.4	4.3	8.5	11.0	0.170	0.270	0.410
560	630	0.460	0.600	0.600	0.760	0.760	0.980	0.230	0.300	3.7	4.8	9.25	12.0	0.200	0.310	0.460
630	710	0.510	0.670	0.670	0.850	0.850	1.090	0.260	0.330	4.2	5.3	10.5	13.0	0.220	0.330	0.520
710	800	0.570	0.750	0.750	0.960	0.960	1.220	0.280	0.370	4.5	5.9	11.5	15.0	0.240	0.390	0.590
800	900	0.640	0.840	0.840	1.070	1.070	1.370	0.310	0.410	5.0	6.6	12.5	16.5	0.280	0.430	0.660
900	1 000	0.710	0.930	0.930	1.190	1.190	1.520	0.340	0.460	5.5	7.4	14.0	18.5	0.310	0.470	0.730
1 000	1 120	0.770	1.030	1.030	1.300	1.300	1.670	0.370	0.500	5.9	8.0	15.0	20.0	0.360	0.530	0.800

Unit: mm

BEARING MAINTENANCE AND INSPECTION

Maintenance

Bearings and operating conditions must be periodically inspected and maintained to maximise bearing life to prevent mechanical failure, ensure reliable operation, raise productivity, and enhance cost performance. Maintenance should be performed regularly according to work standards that may vary according to machine operating conditions. Operating conditions should be monitored, lubricant replenished or changed, and the machine periodically disassembled and overhauled.

1. Inspection under operating conditions

Review lubricant properties, check operating temperatures, and inspect for any vibrations and bearing noise to determine bearing replacement periods and replenishment intervals of the lubricant.

2. Inspection of the bearing

Be sure to thoroughly examine the bearings during periodic machine inspections and part replacement. Check the raceway for any damage and confirm if the bearing can be reused or should be replaced.

Inspection points

Items to be checked while the machine is running should include bearing noise, vibrations, temperature, and lubricant condition.

1. Bearing noise

Sound detection instruments can be used during operation to ascertain the volume and characteristics of bearing rotation noise through sound patterns that are readily distinguishable, which can reveal the presence of bearing damage such as slight flaking. Three typical noise conditions are described in Table 1.

2. Bearing vibration

Bearing irregularities can be analysed by performing a quantitative analysis of vibration amplitude and frequency using a frequency spectrum analyser. Measured data varies depending on the operating conditions of the bearing and the location of the vibration pick-up. Therefore, this method requires the determination of evaluation standards for each measured machine.

Bearing irregularity causes and measures

Irregularities		Possible causes	Measures
Noise	Loud metallic sound	Abnormal load	Improve the fit, internal clearance, preload, or position of housing shoulder
		Incorrect mounting	Improve machining accuracy, alignment accuracy or mounting accuracy of shaft and housing, or use the correct mounting method
		Insufficient or improper lubricant	Replenish the lubricant or select another lubricant
		Contact of rotating parts	Modify the labyrinth seal
	Loud regular sound	Flaws, corrosion, or scratches on race-ways caused by foreign particles	Replace or clean the bearing, improve sealing conditions, or use clean lubricant
		Brinelling	Replace the bearing and use care when handling
		Flaking on raceway	Replace the bearing
	Irregular sound	Excessive clearance	Improve the fit, clearance, or preload
		Contamination by foreign particles	Replace or clean the bearing, improve the seals, and use clean lubricant
		Flaws or flaking on balls	Replace the bearing
Abnormal temperature rise		Excessively small clearance	Improve the fit, clearance, or preload
		Excessive amount of lubricant	Reduce amount of lubricant and select stiffer grease
		Insufficient or improper lubricant	Replenish lubricant or select a proper one
		Abnormal load	Improve the fit, internal clearance, preload, or position of housing shoulder
		Incorrect mounting	Improve machining accuracy, alignment accuracy or mounting accuracy of shaft and housing, or use the correct mounting method
		Creep on fitted surface, or excessive seal friction	Correct the seals, replace the bearing, and correct the fitting or mounting
Vibration (Axial runout)		Brinelling	Replace the bearing, and use care when handling bearings
		Flaking	Replace the bearing
		Incorrect mounting	Correct the squareness between the shaft and housing shoulder or side of spacer
		Penetration of foreign particles	Replace or clean the bearing components and improve sealing
Leakage or discoloration of lubricant		Too much lubricant, or contamination by foreign particles or wear debris	Reduce the amount of lubricant. Select a stiffer grease. Replace the bearing or lubricant. Clean the housing and adjacent parts

EXAMPLES OF BEARING DAMAGE AND COUNTER-MEASURES FOR PAPERMAKING MACHINES

Creep

Bearing type	Application	Cause of damage	Measures
Tapered Roller Bearing	Press CC roll	• Insufficient interference fit	• Tighten interference fit
Spherical Roller Bearing	Dryer canvas roll	• Dimensional variation at high temperatures	• Use TL steel • Use NSKHPS bearing • Apply high-temperature dimensional

Inner ring fracture

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Dryer cylinder roll	• Excessive force applied during mounting • Defective bore face contact • High hoop stress	• Control residual clearance • Adjust with taper gauge • Use TL steel

Rust and corrosion

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Wire suction roll	• Insufficient oil film formation due to water entry	• Reinforce lubricating oil control • Improve bearing housing • Anti-rust treatment for idle periods
	Press suction roll	• Rust formed while stationary or being stored	

Flaking

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Wire suction roll	• Insufficient oil film formation due to water entry	• Reinforce lubricating oil control • Improve bearing housing
	Dryer cylinder roll	• Insufficient oil film formation at high temperatures	• Use TL steel • Increase oil viscosity • Increase volume and reinforce control of lubricating oil temperature • Use thermal insulation sleeve
	Dryer canvas roll	• Excessive axial loading due to expansion of outer ring on the free-end bearing	• Use TL steel • Use NSKHPS bearing • Apply high temperature dimensional stabilizing treatment (S11)

Smearing

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Calender CC roll (triple ring)	• Insufficient oil film formation	• Increase oil viscosity • Increase oil volume and reinforce control of lubricating oil temperature • Add additives to lubricating oil

Electrical corrosion

Bearing type	Application	Cause of damage	Measures
Deep Groove Ball Bearing Cylindrical Roller Bearing	Motor	• Sparks produced by flow of current where rolling elements contact the raceway	• Design electric circuit which prevents current flow through the bearings • Insulate the bearing

MOTION & CONTROL™
NSK

NSK Sales Offices – Europe, Middle East and Africa

UK
NSK UK Ltd.
Northern Road, Newark
Nottinghamshire NG24 2JF
Tel. +44 (0) 1636 605123
Fax +44 (0) 1636 643276
info-uk@nsk.com

France
NSK France S.A.S.
Quartier de l'Europe
2, rue Georges Guynemer
78283 Guyancourt Cedex
Tel. +33 (0) 1 30573939
Fax +33 (0) 1 30570001
info-fr@nsk.com

Middle East
NSK Bearings Gulf Trading Co.
JAFZA View 19, Floor 24 Office 2/3
Jebel Ali Downtown,
PO Box 262163
Dubai, UAE
Tel. +971 (0) 4 804 8205
Fax +971 (0) 4 884 7227
info-me@nsk.com

South Africa
NSK South Africa (Pty) Ltd.
25 Galaxy Avenue
Linbro Business Park
Sandton 2146
Tel. +27 (011) 458 3600
Fax +27 (011) 458 3608
nsk-sa@nsk.com

Germany, Austria, Benelux, Switzerland, Nordic
NSK Deutschland GmbH
Harkortstraße 15
40880 Ratingen
Tel. +49 (0) 2102 4810
Fax +49 (0) 2102 4812290
info-de@nsk.com

Poland & CEE
NSK Polska Sp. z o.o.
Warsaw Branch
Ul. Migdałowa 4/73
02-796 Warszawa
Tel. +48 22 645 15 25
Fax +48 22 645 15 29
info-pl@nsk.com

Spain
NSK Spain, S.A.
C/ Tarragona, 161 Cuerpo Bajo
2ª Planta, 08014 Barcelona
Tel. +34 93 2892763
Fax +34 93 4335776
info-es@nsk.com

Italy
NSK Italia S.p.A.
Via Garibaldi, 215
20024 Garbagnate
Milanese (MI)
Tel. +39 02 995 191
Fax +39 02 990 25 778
info-it@nsk.com

Russia
NSK Polska Sp. z o.o.
Russian Branch
Office I 703, Bldg 29,
18th Line of Vasilievskiy Ostrov,
Saint-Petersburg, 199178
Tel. +7 812 3325071
Fax +7 812 3325072
info-ru@nsk.com

Turkey
NSK Rulmanları Orta Doğu Tic. Ltd. Şti.
Cevizli Mah. D-100 Güney Yan Yol
Kuriş Kule İş Merkezi No:2 Kat:4
Kartal - Istanbul
Tel. +90 216 5000 675
Fax +90 216 5000 676
turkey@nsk.com

Please also visit our website: www.nskeurope.com
Global NSK: www.nsk.com