

# BEARINGS FOR PAPERMAKING MACHINES



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# The NSK brand, recognized around the world

From home electric appliances, automobiles, and large-scale equipment to the aerospace industry—NSK bearings are used in an extensive range of fields. NSK established its global-scale enterprise on technology that has met the exacting requirements of Japanese industry. We have also established R&D systems and support services to meet the diverse needs of our customers throughout the world.

As a brand recognized around the world, NSK continues to lead the industry with its technical prowess.

JAPAN	
Headquarters	1
Production site	22
Sales site	36
R&D center	6

THE AMERICAS		(Locations of bases)
Headquarters	1	U.S.A.
Production site	8	Canada
Sales site	20	Mexico
R&D center	2	Brazil
Representative office	1	Peru Argentina

EUROPE/AFRICA		(Locations of bases)
Headquarters	1	U.K.
Production site	9	Germany
Sales site	15	France
R&D center	3	Italy
Representative office	3	Spain Poland Russia Norway Turkey United Arab Emirates South Africa

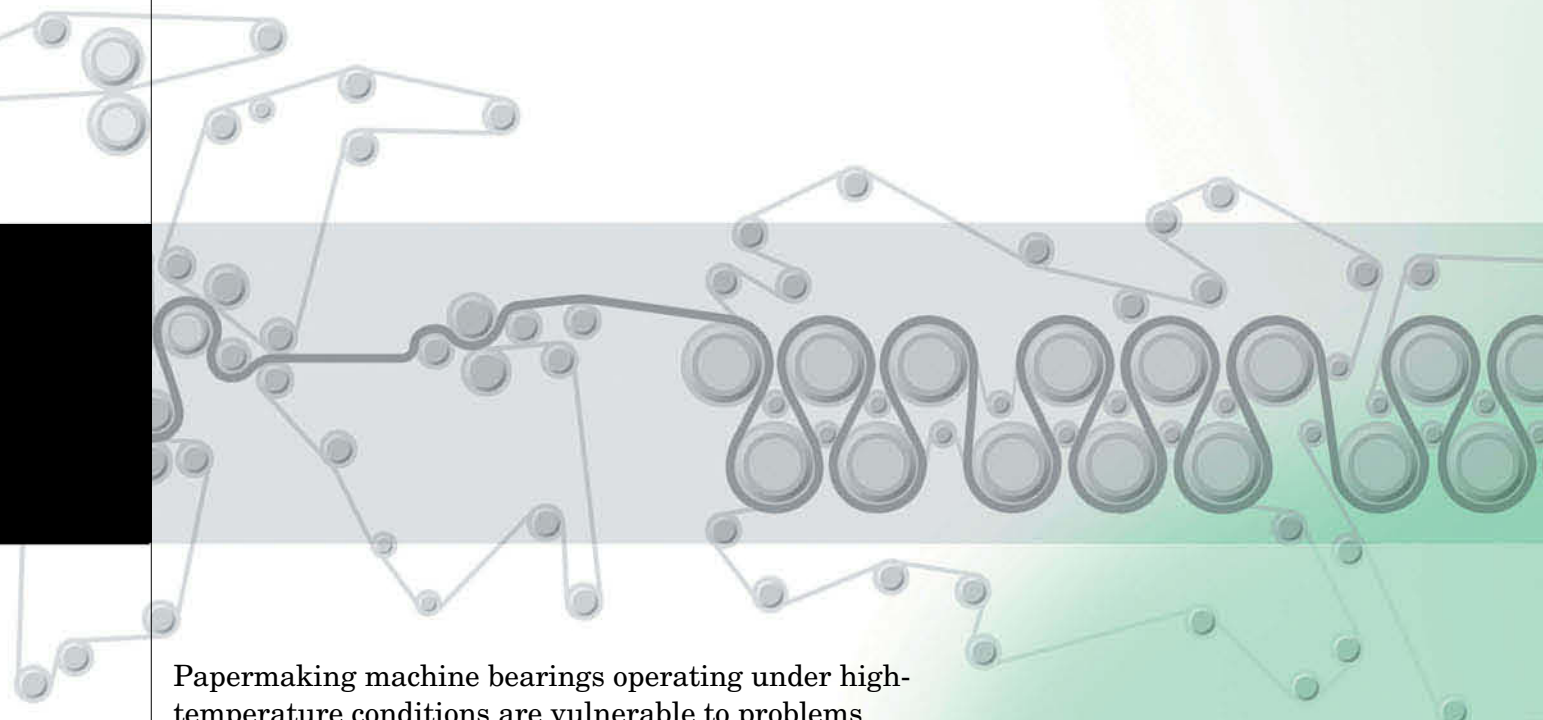
ASIA/OCEANIA		(Locations of bases)
Headquarters	3	Singapore
Production site	25	Indonesia
Sales site	50	Thailand
R&D center	3	Malaysia
Representative office	3	Philippines Vietnam India Australia New Zealand China South Korea Taiwan

As of March 2013

NSK JAPAN HK-8  
TL23152CAG3MKE4C3S1.1

Solution Provider NSK

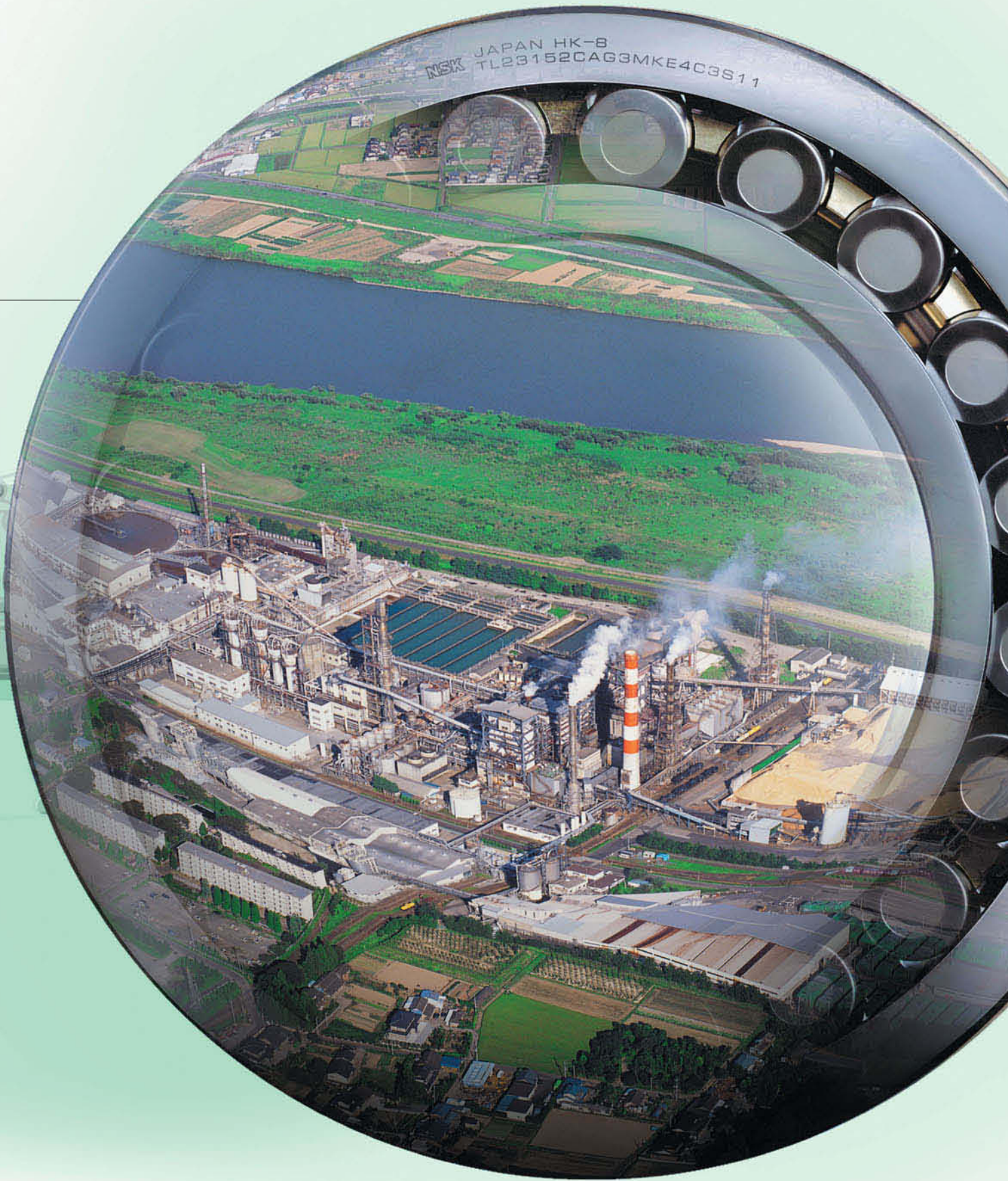
# The high quality and toughness of NSK bearings reduce maintenance costs in the papermaking industry.



Papermaking machine bearings operating under high-temperature conditions 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.



NSK JAPAN HK-8  
TL23152CAG3MKE4C3S11





## Key to Bearing Specifications:

- |  |   |
|--|---|
| ① <b>Bearing type</b><br>SR: Spherical Roller Bearing<br>TR: Tapered Roller Bearing<br>B: Ball Bearing | ③ <b>Bearing series</b>                       |
| ② <b>Bearing inner ring bore diameter</b>  | ④ <b>Internal clearance / tolerance class</b> |
|  | ⑤ <b>Lubrication</b>                          |
|  | ⑥ <b>Others</b>                               |

### 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      |

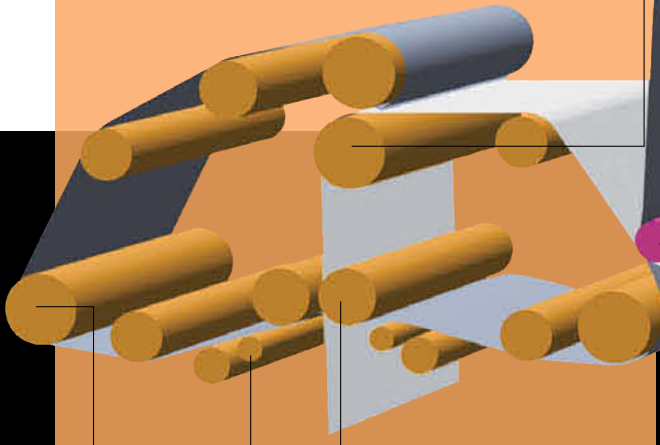
### Felt Roll

- ① TR
- ② 60.325–146.05
- ③ Inch series
- ④ Normal / P0
- ⑤ Grease

### Press Roll (1P–4P)

- ① SR
- ② 300–480
- ③ 230, 231, 232XX
- ④ Normal / P0 or P55
- ⑤ Grease or oil circulation
- ⑥ CCR: Triple Ring Bearing

### Wire Section



### Breast Roll

- ① TR (or SR)
- ② 101.6–177.8
- ③ Inch series (or 223XX)
- ④ Normal or C3 / P0
- ⑤ Grease

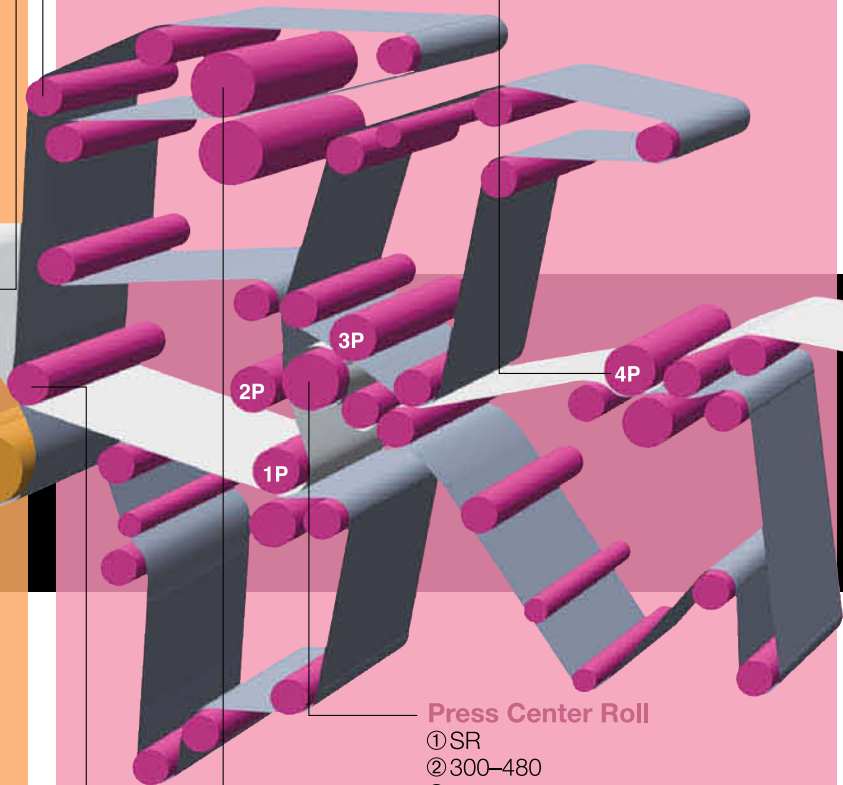
### Expander Roll

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

### Turning Roll

- ① TR (or SR)
- ② 101.6–177.8
- ③ Inch series (or 223XX)
- ④ Normal or C3 / P0
- ⑤ Grease

### Press Section



### Press Center Roll

- ① SR
- ② 300–480
- ③ 230, 231, 232XX
- ④ Normal / P0
- ⑤ Oil circulation

### Wringer Roll

- ① SR
- ② 190–380
- ③ 231, 232, 223XX
- ④ Normal or C3 / P0
- ⑤ Oil circulation

### Suction Pick-Up Roll

- | Front             | Back              | Back-internal |
|-------------------|-------------------|---------------|
| ① SR              | ① SR              | ① SR          |
| ② 320–480         | ② 260–400         | ② 110–130     |
| ③ 239, 230, 231XX | ③ 230, 231XX      | ③ 232XX       |
| ④ C3 / P55        | ④ C3 / P55        | ④ C3 / P0     |
| ⑤ Oil circulation | ⑤ Oil circulation | ⑤ Grease      |

# The Papermaking Process and Spherical Roller Bearing Specifications

## Canvas Roll

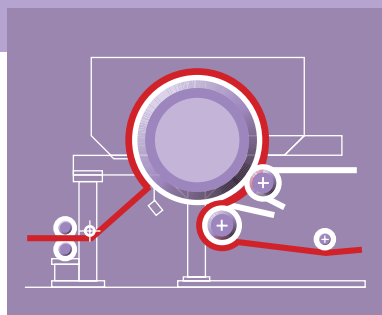
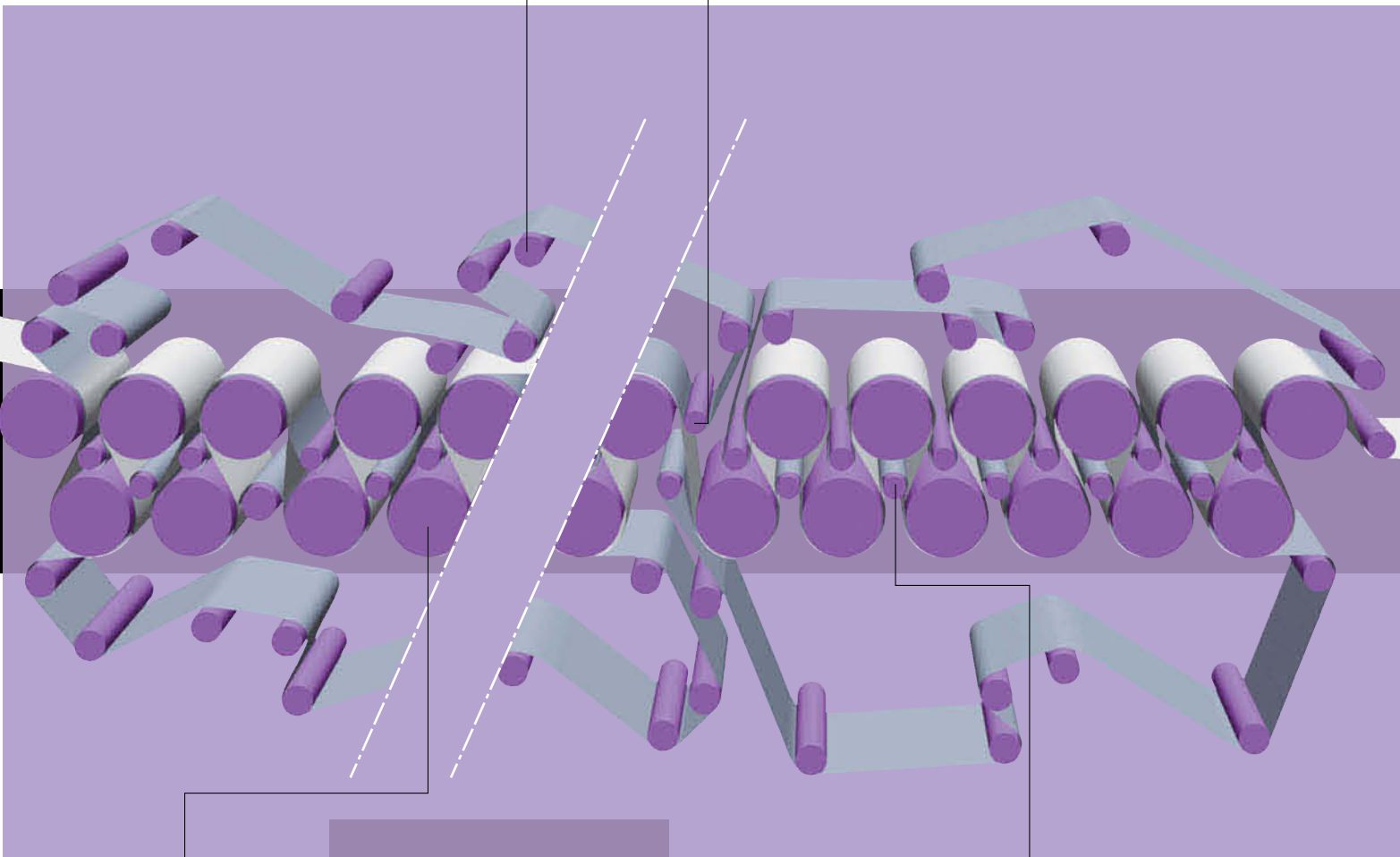
- ① SR
- ② 50–110
- ③ 223XX
- ④ C3 / P0
- ⑤ Oil circulation
- ⑥ Heat treatment: TL or S11

## Paper Roll

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

## Breaker Stack Bottom Roll

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



## 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

## Drying Cylinder

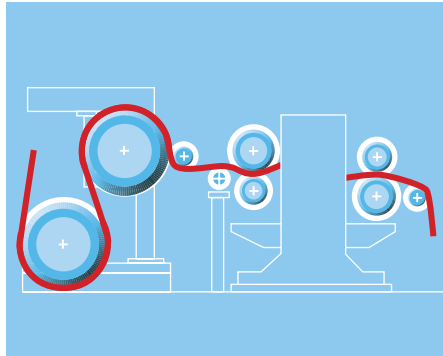
- ① SR
- ② 160–300
- ③ 230, 231, 222, 232XX
- ④ C3 or C4 / P0
- ⑤ Oil circulation
- ⑥ Heat treatment: TL

## PV Roll

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

### 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



### Reel Spreader Roll

- ① SR
- ② 60–70
- ③ 223XX
- ④ Normal / P0
- ⑤ Grease

### Reel Drum Roll

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

## Dryer Section

## Calender Section

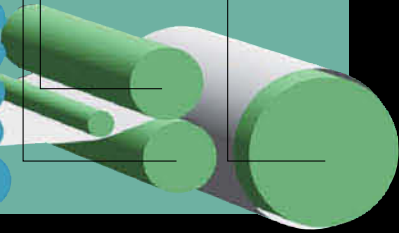
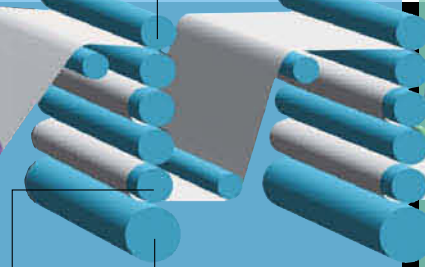
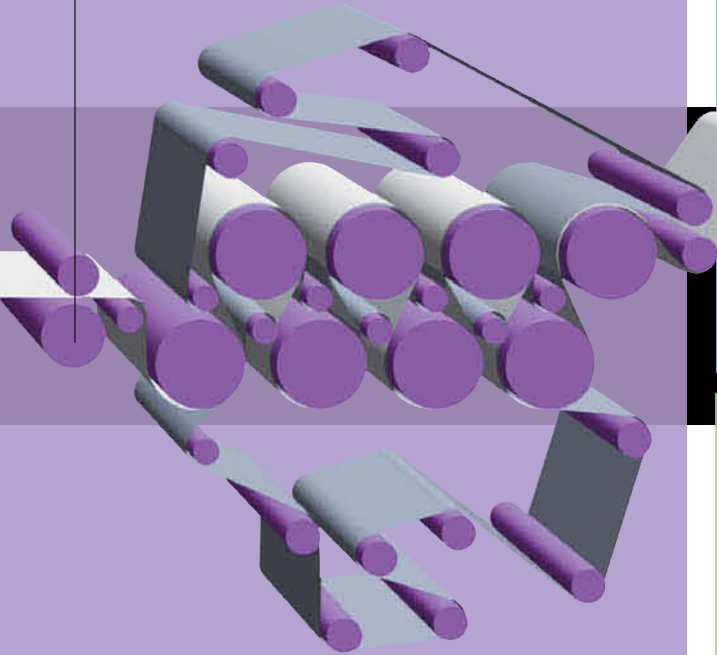
## Reel

### Calender Top Roll

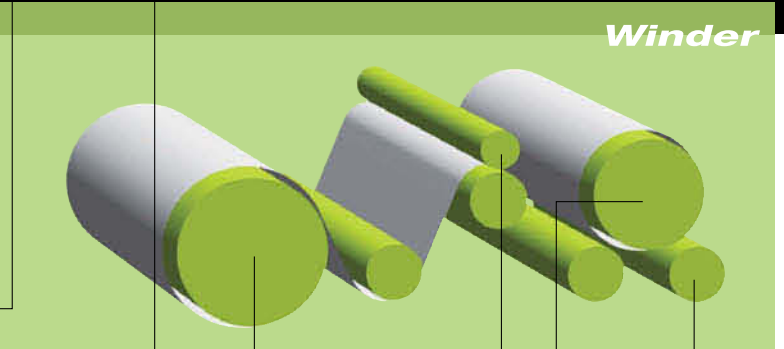
- ① SR
- ② 220–280
- ③ 230XX
- ④ Normal / P0
- ⑤ Oil circulation

### Reel Spool Roll

- ① TR
- ② 130–180
- ③ 322XX
- ④ Normal / P0
- ⑤ Grease



## Winder



### Calender Bottom Roll

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

### Paper Roll

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

### Rider Roll

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

### Calender Queen Roll

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

### Unwinding Stand

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

### Winder Drum Roll

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





### TL Series Spherical Roller Bearings

Ideal for high temperature equipment, with resistance to inner ring fracture. Tough, long-life TL bearings boost productivity and lower costs.

Major applications: dryer rolls, canvas rolls, PV rolls, and calender rolls



### NSKHPS Spherical Roller Bearings

Next-generation standard bearings utilizing innovative materials and technologies benefit from NSK's experience and expertise to deliver longer life and higher limiting speed.

Major applications: small diameter rolls such as canvas rolls, paper rolls, felt rolls, and rider rolls



### Molded-Oil™ Bearings

Excellent performance in environments exposed to moisture or paper dust, without oil leakage. Molded oil using an optimized molding method with optimal composition provides higher speed operation, is easy to handle, and safe for the environment.

Major applications: raw material conveyors, carrier rope sheaves, suction rolls



### EM Series Cylindrical Roller Bearings

Bearings with integrated machined cages offer enhanced performance by combining the advantages of the conventional M series bearings and the high-load EMA1 series.

Major applications: motors and pumps



### Triple Ring Bearings

Uniquely structured bearing for ease of use and no creep while offering high precision and long life.

Major applications: press rolls, breaker stack rolls



### CA Series Spherical Roller Bearings

Superior radial load capacity and alignment, featuring high load capacity and excellent strength; equipped with a machined cage. This product lineup includes high running accuracy to ISO tolerance class 5.

Major applications: large diameter rolls such as suction rolls, press rolls, calender rolls and reel drum rolls.



### Deep Groove Ball Bearings for High-Speed Expander Rolls

Special bearings that suppress friction torque and surface damage such as smearing and others.

**A Product Line  
that Matches  
Specific  
Applications**

NSK offers other advantageous products for various rolls and conveyors, including the HR series of high load capacity tapered roller bearings and easy-to-handle ball bearing units.

# TL Series Spherical Roller Bearings

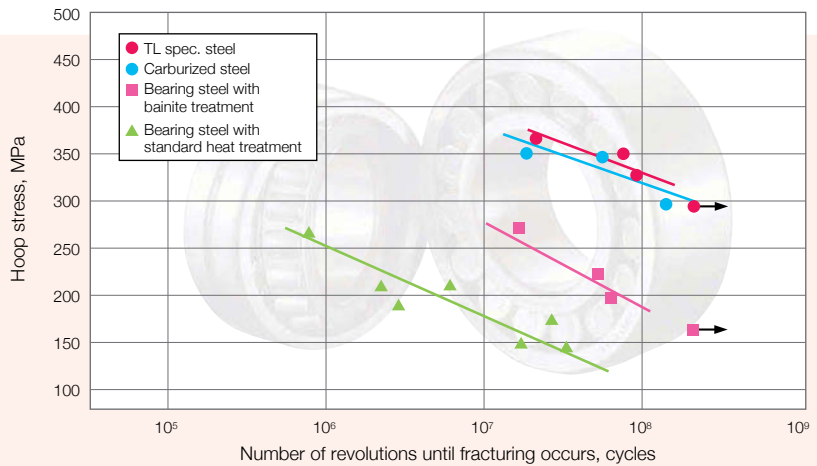
Dryer rolls are generally used under high-temperature conditions, which can lead to fracturing of the bearing inner ring, and in the worst case, result in work stoppage. NSK's solution is the TL (Tough and Long-life) bearing, which features sufficient strength to resist inner ring fractures, superior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



## Features

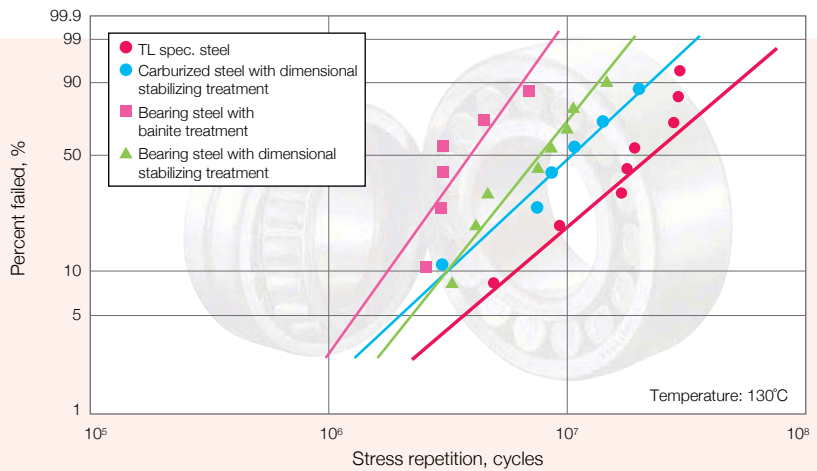
### Enhanced inner ring strength

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.



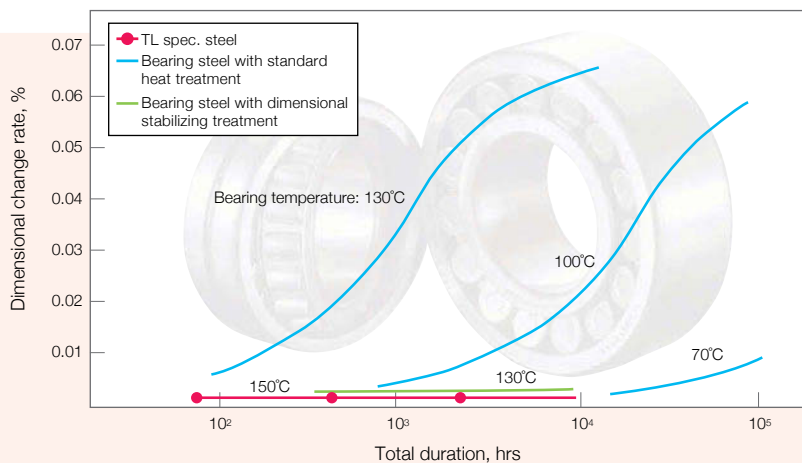
### Longer life

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



### Dimensional stability under high temperatures

High-temperature dimensional stabilization 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 with that of conventional bearings by optimization 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 only).

Limiting speed has been increased by a maximum of 20 % compared with that of 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.

## CA Series Spherical Roller Bearings

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 characterized by high performance and quality of the No. 1 brand 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. Oil 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

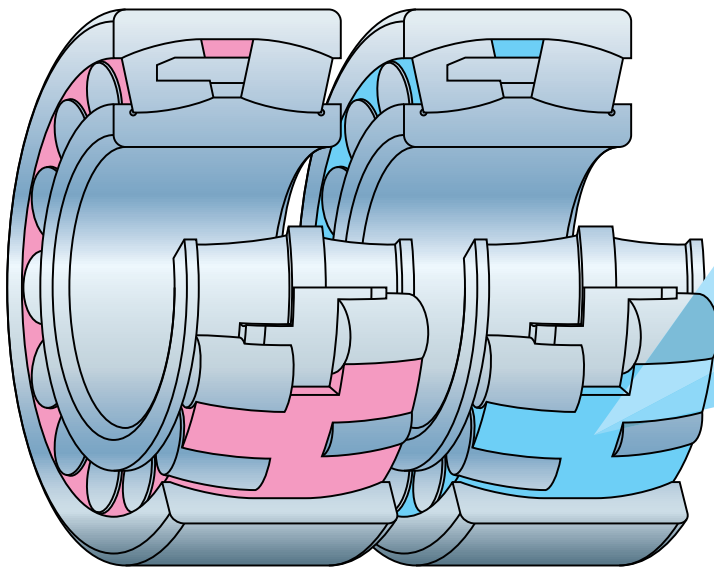
Packing with Molded-Oil™ after providing the bearing surface with special treatment realizes smooth rotation of rolling elements.

### Environmentally friendly

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

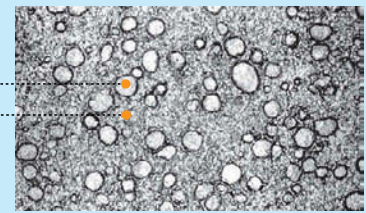
## Applications

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



Close-up of Molded-Oil™ | 100 µm

### Portion containing mostly lubricating oil

The lubricating oil is mineral oil-based.

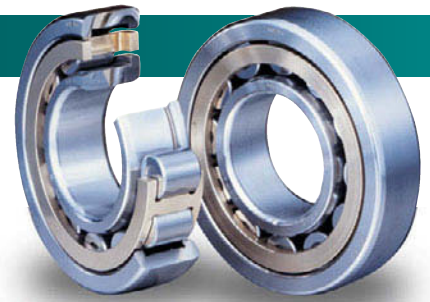
### Portion containing mostly polyolefin

Polyolefin is an environmentally sound material used for packaging food in supermarkets, replacing dioxin-generating vinyl chloride.

Be aware that this bearing has certain restrictions in regards to ambient operating temperatures and limiting speeds ( $d_m n$ ). Refer to the NSK Molded-Oil™ Bearings catalog (Cat. No. E1216) for details. Furthermore, handling precautions for maintaining the excellent, long-term lubricating capacity of the Molded-Oil™ bearings are listed on page 3 of the same catalog.

## EM Series Cylindrical Roller Bearings

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.



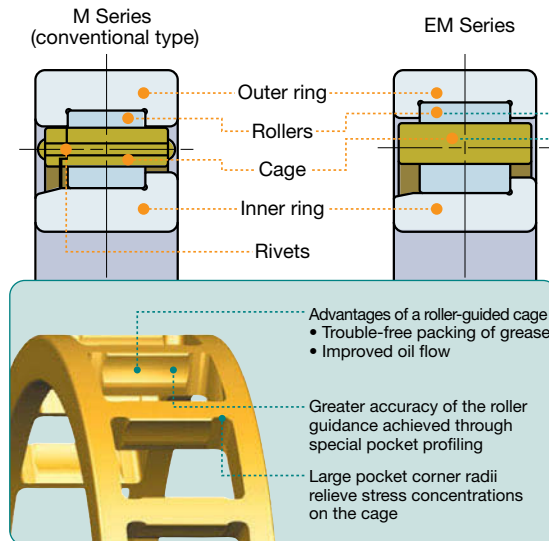
**Features** Series are available in bearing inner bore dimensions ranging from 25 mm to 200 mm

### Compared to the conventional M Series:

Bearing life  
approximately **2 times**

Low vibration and noise  
**50% to 60% less**

Cage strength  
**dramatically enhanced**  
(generated stress cut in half)



**High load rating**  
Greater number of larger rollers

**Low vibration and noise**  
One-piece cage provides greater accuracy. Roller-guided cage achieves lower running temperature and quieter operation.

**High-strength and wear-resistant cage**  
Well-balanced one-piece design

Catalog No. E1237

## 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

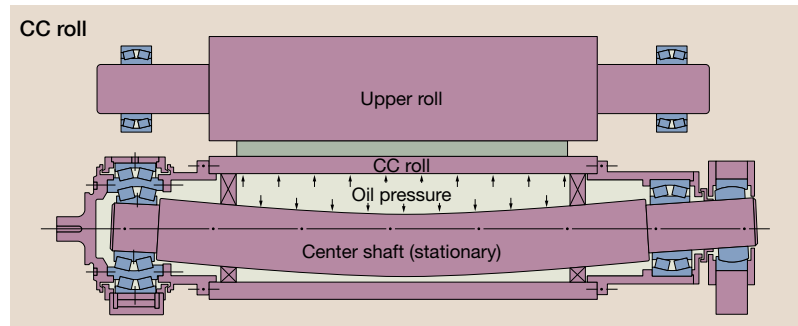
**High-load capacity design**

**Long life**  
(uses vacuum melted, carburized steel)

**High precision**  
(dimensional and rotational precision)

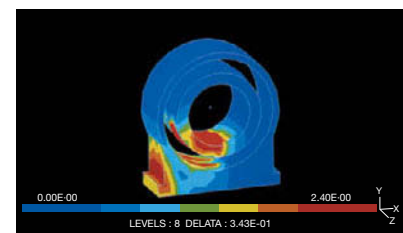
**Optimal inner ring design for lubrication**

**Lubrication hole and groove provided on inner and outer rings**



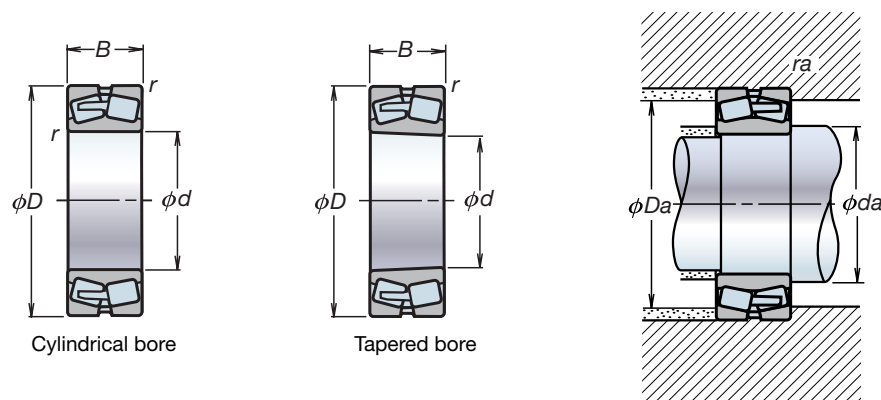
### Finite element analysis of housing design for triple ring bearings.

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



Maximum principle stress distribution

# TL Series Spherical Roller Bearings



Dynamic equivalent load

$$P = X F_r + Y F_a$$

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

Static equivalent load

$$P_0 = F_r + Y_0 F_a$$

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

Boundary dimensions (mm)				Basic load ratings (N)		Limiting speeds (min <sup>-1</sup> )		Bearing numbers	
$d$	$D$	$B$	$r$ (min.)	$C_r$	$C_{or}$	Grease	Oil	Cylindrical bore	Tapered bore (1)
65	140	48	2.1	375 000	380 000	3 200	4 000	TL22313EAE4	TL22313EAKE4
70	150	51	2.1	425 000	435 000	3 000	3 800	TL22314EAE4	TL22314EAKE4
90	190	64	3	665 000	705 000	2 400	3 000	TL22318EAE4	TL22318EAKE4
100	215	73	3	860 000	930 000	2 000	2 600	TL22320EAE4	TL22320EAKE4
110	170	45	2	293 000	465 000	2 000	2 400	TL23022CDE4	TL23022CDKE4
110	200	69.8	2.1	515 000	760 000	1 500	1 900	TL23222CE4	TL23222CKE4
110	240	80	3	825 000	1 120 000	1 700	2 200	TL22322EAE4	TL22322EAKE4
120	260	86	3	955 000	1 320 000	1 600	2 000	TL22324EAE4	TL22324EAKE4
130	280	93	4	995 000	1 350 000	1 300	1 600	TL22326CAE4	TL22326CAKE4
140	210	53	2	420 000	715 000	1 600	1 900	TL23028CDE4	TL23028CDKE4
140	250	68	3	645 000	930 000	1 400	1 700	TL22228CDE4	TL22228CDKE4
140	250	88	3	835 000	1 300 000	1 100	1 500	TL23228CE4	TL23228CKE4
150	225	56	2.1	470 000	815 000	1 400	1 800	TL23030CDE4	TL23030CDKE4
150	250	80	2.1	725 000	1 180 000	1 100	1 400	TL23130CAE4	TL23130CAKE4
150	270	73	3	765 000	1 120 000	1 300	1 600	TL22230CDE4	TL22230CDKE4
150	320	108	4	1 220 000	1 690 000	1 100	1 400	TL22330CAE4	TL22330CAKE4
160	240	60	2.1	540 000	955 000	1 300	1 700	TL23032CDE4	TL23032CDKE4
160	290	80	3	910 000	1 320 000	1 200	1 500	TL22232CDE4	TL22232CDKE4
160	290	104	3	1 100 000	1 770 000	1 000	1 300	TL23232CE4	TL23232CKE4
170	230	45	2	350 000	660 000	1 400	1 800	TL23934BCAE4	TL23934BCAKE4
170	260	67	2.1	640 000	1 090 000	1 200	1 600	TL23034CDE4	TL23034CDKE4
170	280	88	2.1	940 000	1 570 000	1 000	1 300	TL23134CAE4	TL23134CAKE4
170	360	120	4	1 580 000	2 110 000	1 000	1 200	TL22334CAE4	TL22334CAKE4
180	280	74	2.1	750 000	1 270 000	1 200	1 400	TL23036CDE4	TL23036CDKE4
180	320	112	4	1 300 000	2 110 000	850	1 100	TL23236CAE4	TL23236CAKE4
190	290	75	2.1	775 000	1 350 000	1 100	1 400	TL23038CAE4	TL23038CAKE4
190	320	104	3	1 190 000	2 020 000	850	1 100	TL23138CAE4	TL23138CAKE4
190	340	92	4	1 140 000	1 730 000	1 000	1 200	TL22238CAE4	TL22238CAKE4
190	340	120	4	1 440 000	2 350 000	800	1 100	TL23238CAE4	TL23238CAKE4
190	400	132	5	1 890 000	2 590 000	900	1 100	TL22338CAE4	TL22338CAKE4
200	310	82	2.1	940 000	1 700 000	1 000	1 300	TL23040CAE4	TL23040CAKE4
200	340	112	3	1 360 000	2 330 000	800	1 000	TL23140CAE4	TL23140CAKE4
200	360	98	4	1 300 000	2 010 000	950	1 200	TL22240CAE4	TL22240CAKE4
200	360	128	4	1 660 000	2 750 000	750	1 000	TL23240CAE4	TL23240CAKE4
220	340	90	3	1 090 000	1 980 000	950	1 200	TL23044CAE4	TL23044CAKE4
220	370	120	4	1 570 000	2 710 000	710	950	TL23144CAE4	TL23144CAKE4
220	400	108	4	1 570 000	2 430 000	850	1 000	TL22244CAE4	TL22244CAKE4
220	400	144	4	2 010 000	3 400 000	670	900	TL23244CAE4	TL23244CAKE4
220	460	145	5	2 350 000	3 400 000	750	950	TL22344CAE4	TL22344CAKE4
240	320	60	2.1	635 000	1 300 000	950	1 200	TL23948CAE4	TL23948CAKE4
240	360	92	3	1 160 000	2 140 000	850	1 100	TL23048CAE4	TL23048CAKE4
240	400	128	4	1 790 000	3 100 000	670	850	TL23148CAE4	TL23148CAKE4
240	500	155	5	2 600 000	3 800 000	670	850	TL22348CAE4	TL22348CAKE4
260	360	75	2.1	930 000	1 870 000	850	1 000	TL23952CAE4	TL23952CAKE4
260	400	104	4	1 430 000	2 580 000	800	950	TL23052CAE4	TL23052CAKE4
260	440	144	4	2 160 000	3 750 000	600	800	TL23152CAE4	TL23152CAKE4
280	380	75	2.1	925 000	1 950 000	800	950	TL23956CAE4	TL23956CAKE4
280	420	106	4	1 540 000	2 950 000	710	900	TL23056CAE4	TL23056CAKE4
280	460	146	5	2 230 000	4 000 000	560	750	TL23156CAE4	TL23156CAKE4
280	500	176	5	2 880 000	4 900 000	530	670	TL23256CAE4	TL23256CAKE4
300	420	90	3	1 230 000	2 490 000	710	900	TL23960CAE4	TL23960CAKE4
300	460	118	4	1 920 000	3 700 000	670	850	TL23060CAE4	TL23060CAKE4
300	500	160	5	2 670 000	4 800 000	500	670	TL23160CAE4	TL23160CAKE4
300	540	192	5	3 400 000	5 900 000	480	630	TL23260CAE4	TL23260CAKE4
320	540	176	5	3 050 000	5 500 000	480	600	TL23164CAE4	TL23164CAKE4
340	520	133	5	2 280 000	4 400 000	560	710	TL23068CAE4	TL23068CAKE4
340	580	190	5	3 600 000	6 600 000	430	560	TL23168CAE4	TL23168CAKE4
360	540	134	5	2 390 000	4 700 000	530	670	TL23072CAE4	TL23072CAKE4
380	520	106	4	1 870 000	4 100 000	530	670	TL23976CAE4	TL23976CAKE4

Note (1) The suffix K indicates that the bearing has a tapered bore (taper 1:12). Remarks The suffix E4 indicates that the bearing has an oil groove and holes.



# Bearing Nomenclature

Example : **TL 23152 CA g3 M K E4 C3 S11**

Spherical roller bearings (Bearing type);  
Width series 3 (Bearing series symbols);  
Diameter series 1 (Bearing series symbols);  
Bearing bore 260 mm (Bore number)

Machined brass cage (Cage type symbol)

Max. operating temperature: less than 200°C  
(Special specification symbol)

Radial clearance C3 (Internal clearance symbol)

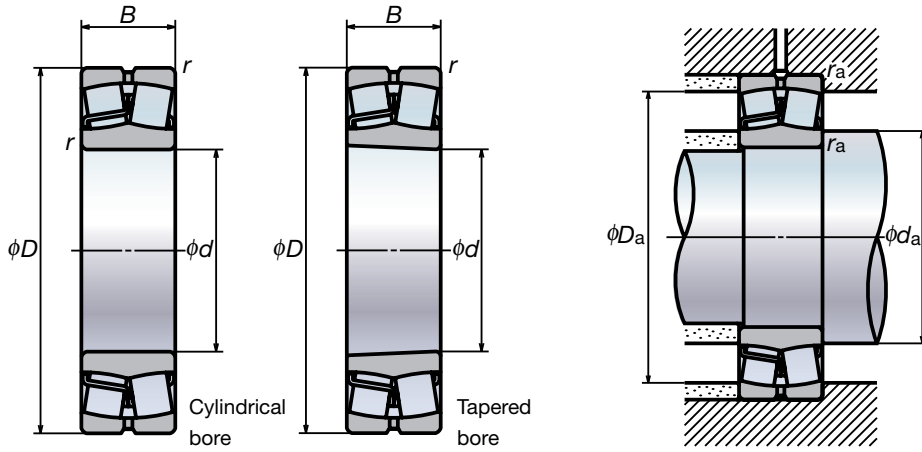
Outer ring with oil groove and oil holes (External features symbol)

Tapered bore (External features symbol)

TL spec. Inner ring. (Special spec, material symbol) g5: Inner and outer ring

Abutment and fillet dimensions (mm)					Constant	Axial load factors			Mass
(min.)	$d_a$ (max.)	(max.)	$D_a$ (min.)	$r_a$ (max.)	$e$	$Y_2$	$Y_3$	$Y_0$	(kg) approx.
77	84	128	119	2	0.33	3.0	2.0	2.0	3.52
82	91	138	129	2	0.33	3.0	2.0	2.0	4.28
104	115	176	163	2.5	0.33	3.1	2.1	2.0	8.56
114	130	201	184	2.5	0.33	3.0	2.0	2.0	12.7
120	124	160	153	2	0.24	4.2	2.8	2.8	3.76
122	130	188	170	2	0.34	3.0	2.0	1.9	9.54
124	145	226	206	2.5	0.30	3.1	2.1	2.0	17.6
134	157	246	222	2.5	0.32	3.1	2.1	2.0	22.2
148	—	262	236	3	0.34	2.9	2.0	1.9	27.8
150	157	200	190	2	0.22	4.5	3.0	2.9	6.49
154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
154	163	236	213	2.5	0.35	2.9	1.9	1.9	18.8
162	168	213	203	2	0.22	4.6	3.1	3.0	7.90
162	—	238	218	2	0.30	3.4	2.3	2.2	15.8
164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
168	—	302	270	3	0.35	2.9	1.9	1.9	41.5
172	179	228	216	2	0.22	4.5	3.0	2.9	9.66
174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5
180	—	220	213	2	0.17	5.8	3.9	3.8	5.38
182	191	248	233	2	0.23	4.3	2.9	2.8	13.0
182	—	268	245	2	0.29	3.5	2.3	2.3	21.0
188	—	342	304	3	0.35	2.9	1.9	1.9	57.9
192	202	268	249	2	0.24	4.2	2.8	2.8	17.1
198	—	302	274	3	0.35	2.9	1.9	1.9	38.5
202	—	278	261	2	0.24	4.2	2.8	2.8	17.6
204	—	306	276	3.5	0.31	3.2	2.2	2.1	34.0
208	—	322	296	3	0.26	3.8	2.6	2.5	35.5
208	—	322	288	3	0.35	2.9	1.9	1.9	46.5
212	—	378	338	4	0.34	2.9	2.0	1.9	77.6
212	—	298	279	2	0.25	4.0	2.7	2.6	22.6
214	—	326	293	2.5	0.32	3.2	2.1	2.1	41.5
218	—	342	315	3	0.26	3.8	2.6	2.5	42.6
218	—	342	307	3	0.35	2.9	1.9	1.9	57.0
234	—	326	302	2.5	0.24	4.1	2.8	2.7	29.7
238	—	352	320	3	0.31	3.2	2.2	2.1	52.0
238	—	382	348	3	0.27	3.7	2.5	2.4	59.0
238	—	382	337	3	0.36	2.8	1.9	1.8	79.5
242	—	438	391	4	0.33	3.0	2.0	2.0	116
252	—	308	298	2	0.17	6.0	4.0	3.9	13.3
254	—	346	324	2.5	0.24	4.2	2.8	2.7	32.6
258	—	382	347	3	0.31	3.3	2.2	2.2	64.5
262	—	478	423	4	0.32	3.2	2.1	2.1	147
272	—	348	333	2	0.19	5.4	3.6	3.5	23.0
278	—	382	356	3	0.25	4.1	2.7	2.7	46.6
278	—	422	380	3	0.32	3.2	2.1	2.1	88.2
292	—	368	351	2	0.18	5.7	3.9	3.8	24.5
298	—	402	377	3	0.24	4.2	2.8	2.7	50.5
302	—	438	400	4	0.30	3.3	2.2	2.2	94.3
302	—	478	425	4	0.35	2.9	1.9	1.9	147
314	—	406	386	2.5	0.19	5.2	3.5	3.4	38.2
318	—	442	413	3	0.24	4.2	2.8	2.7	70.5
322	—	478	433	4	0.31	3.3	2.2	2.2	125
322	—	518	458	4	0.35	2.9	1.9	1.9	189
342	—	518	466	4	0.31	3.2	2.1	2.1	162
362	—	498	465	4	0.24	4.2	2.8	2.8	101
362	—	558	499	4	0.31	3.2	2.1	2.1	206
382	—	518	485	4	0.24	4.2	2.8	2.8	106
398	—	502	482	3	0.18	5.5	3.7	3.6	65.4

# NSKHPS Spherical Roller Bearings



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

$$P_0 = F_r + Y_0 F_a$$

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

Boundary dimensions (mm)				Basic load ratings (N)		Limiting speeds (min <sup>-1</sup> )		Bearing numbers		Abutment and fillet dimensions (mm)				Constant	Axial load factors			
d	D	B	r (min.)	$C_r$	$C_{0r}$	Grease	Oil	Cylindrical bore	Tapered bore (°)	da (min.)	da (max.)	Da (max.)	ra (min.)	ra (max.)	e	Y2	Y3	Y0
40	80	23	1.1	113 000	99 500	6 700	8 500	22208EAE4	22208EAKE4	47	49	73	70	1	0.28	3.6	2.4	2.4
	90	23	1.5	118 000	111 000	6 000	7 500	21308EAE4	21308EAKE4	49	54	81	75	1.5	0.25	3.9	2.7	2.6
45	90	33	1.5	170 000	153 000	5 300	6 700	22308EAE4	22308EAKE4	49	52	81	77	1.5	0.35	2.8	1.9	1.9
	85	23	1.1	118 000	111 000	6 000	7 500	22209EAE4	22209EAKE4	52	54	78	75	1	0.25	3.9	2.7	2.6
50	100	25	1.5	149 000	144 000	5 000	6 300	21309EAE4	21309EAKE4	54	65	91	89	1.5	0.23	4.3	2.9	2.8
	100	36	1.5	207 000	195 000	4 500	5 600	22309EAE4	22309EAKE4	54	59	91	86	1.5	0.34	2.9	2.0	1.9
55	90	23	1.1	124 000	119 000	5 600	7 100	22210EAE4	22210EAKE4	57	60	83	81	1	0.24	4.3	2.9	2.8
	110	27	2	178 000	175 000	4 500	5 600	21310EAE4	21310EAKE4	60	72	100	98	2	0.23	4.4	3.0	2.9
60	110	40	2	246 000	234 000	4 300	5 300	22310EAE4	22310EAKE4	60	64	100	93	2	0.35	2.8	1.9	1.9
	100	25	1.5	149 000	144 000	5 300	6 700	22211EAE4	22211EAKE4	64	65	91	89	1.5	0.23	4.3	2.9	2.8
65	120	29	2	178 000	174 000	4 500	5 600	21311EAE4	21311EAKE4	65	72	110	98	2	0.23	4.4	3.0	2.9
	120	43	2	292 000	292 000	3 800	4 800	22311EAE4	22311EAKE4	65	73	110	103	2	0.34	2.9	2.0	1.9
70	110	28	1.5	178 000	174 000	4 800	6 000	22212EAE4	22212EAKE4	69	72	101	98	1.5	0.23	4.4	3.0	2.9
	130	31	2.1	238 000	244 000	3 800	4 800	21312EAE4	21312EAKE4	72	87	118	117	2	0.22	4.5	3.0	3.0
75	130	46	2.1	340 000	340 000	3 600	4 500	22312EAE4	22312EAKE4	72	79	118	111	2	0.34	3.0	2.0	1.9
	120	31	1.5	221 000	230 000	4 300	5 300	22213EAE4	22213EAKE4	74	80	111	107	1.5	0.24	4.2	2.8	2.7
80	140	33	2.1	264 000	275 000	3 600	4 500	21313EAE4	21313EAKE4	77	94	128	126	2	0.22	4.6	3.1	3.0
	140	48	2.1	375 000	380 000	3 200	4 000	22313EAE4	22313EAKE4	77	84	128	119	2	0.33	3.0	2.0	2.0
85	125	31	1.5	225 000	232 000	4 000	5 300	22214EAE4	22214EAKE4	79	84	116	111	1.5	0.23	4.3	2.9	2.8
	150	35	2.1	310 000	325 000	3 200	4 000	21314EAE4	21314EAKE4	82	101	138	135	2	0.22	4.6	3.1	3.0
90	150	51	2.1	425 000	435 000	3 000	3 800	22314EAE4	22314EAKE4	82	91	138	129	2	0.33	3.0	2.0	2.0
	130	31	1.5	238 000	244 000	4 000	5 000	22215EAE4	22215EAKE4	84	87	121	117	1.5	0.22	4.5	3.0	3.0
95	160	37	2.1	310 000	325 000	3 200	4 000	21315EAE4	21315EAKE4	87	101	148	134	2	0.22	4.6	3.1	3.0
	160	55	2.1	485 000	505 000	2 800	3 600	22315EAE4	22315EAKE4	87	97	148	137	2	0.33	3.0	2.0	2.0
100	140	33	2	264 000	275 000	3 600	4 500	22216EAE4	22216EAKE4	90	94	130	126	2	0.22	4.6	3.1	3.0
	170	39	2.1	355 000	375 000	3 000	3 800	21316EAE4	21316EAKE4	92	109	158	146	2	0.23	4.4	3.0	2.9
105	170	58	2.1	540 000	565 000	2 600	3 400	22316EAE4	22316EAKE4	92	103	158	145	2	0.33	3.0	2.0	2.0
	150	36	2	310 000	325 000	3 400	4 300	22217EAE4	22217EAKE4	95	101	140	135	2	0.22	4.6	3.1	3.0
110	180	41	3	360 000	395 000	3 000	4 000	21317EAE4	21317EAKE4	99	108	166	142	2.5	0.24	4.3	2.9	2.8
	180	60	3	600 000	630 000	2 400	3 200	22317EAE4	22317EAKE4	99	110	166	155	2.5	0.33	3.1	2.1	2.0
115	160	40	2	360 000	395 000	3 200	4 000	22218EAE4	22218EAKE4	100	108	150	142	2	0.24	4.3	2.9	2.8
	190	43	3	415 000	450 000	2 800	3 600	21318EAE4	21318EAKE4	104	115	176	152	2.5	0.24	4.3	2.9	2.8
120	190	64	3	665 000	705 000	2 400	3 000	22318EAE4	22318EAKE4	104	115	176	163	2.5	0.33	3.1	2.1	2.0
	170	43	2.1	415 000	450 000	3 000	3 800	22219EAE4	22219EAKE4	107	115	158	152	2	0.24	4.3	2.9	2.8
125	200	45	3	430 000	435 000	1 500	2 000	21319CAME4	21319CAMKE4	109	127	186	172	2.5	0.22	4.6	3.1	3.0
	200	67	3	735 000	780 000	2 200	2 800	22319EAE4	22319EAKE4	109	121	186	172	2.5	0.33	3.1	2.1	2.0
130	180	46	2.1	455 000	490 000	2 800	3 600	22220EAE4	22220EAKE4	112	119	168	160	2	0.24	4.3	2.9	2.8
	180	60.3	2.1	525 000	605 000	1 600	2 200	23220CAME4	23220CAMKE4	112	118	168	155	2	0.32	3.2	2.1	2.1
135	215	47	3	495 000	485 000	1 400	1 900	21320CAME4	21320CAMKE4	114	133	201	184	2.5	0.23	4.4	3.0	2.9
	215	73	3	860 000	930 000	2 000	2 600	22320EAE4	22320EAKE4	114	130	201	184	2.5	0.33	3.0	2.0	2.0
140	180	56	2	480 000	630 000	1 600	2 000	23122CAME4	23122CAMKE4	120	127	170	158	2	0.28	3.5	2.4	2.3
	180	69	2	575 000	750 000	1 600	2 000	24122CAME4	24122CAMKE4	120	123	170	154	2	0.36	2.8	1.9	1.8
145	200	53	2.1	605 000	645 000	2 600	3 200	22222EAE4	22222EAKE4	122	129	188	178	2	0.25	4.0	2.7	2.6
	200	69.8	2.1	645 000	760 000	1 500	1 900	23222CAME4	23222CAMKE4	122	130	188	170	2	0.34	3.0	2.0	1.9
150	240	50	3	565 000	545 000	1 300	1 700	21322CAME4	21322CAMKE4	124	-	226	206	2.5	0.22	4.6	3.1	3.0
	240	80	3	1 030 000	1 120 000	1 900	2 400	22322EAE4	22322EAKE4	124	145	226	206	2.5	0.33	3.1	2.1	2.0
155	180	46	2	395 000	525 000	1 800	2 200	23024CAME4	23024CAMKE4	130	134	170	163	2	0.22	4.5	3.0	2.9
	180	60	2	480 000	680 000	1 500	2 000	24024CAME4	24024CAMKE4	130	131	170	158	2	0.32	3.2	2.1	2.1
160	200	62	2	580 000	720 000	1 400	1 800	23124CAME4	23124CAMKE4	130	138	190	175	2	0.29	3.5	2.4	2.3
	200	80	2	695 000	905 000	1 400	1 800	24124CAME4	24124CAMKE4	130	136	190	171	2	0.37	2.7	1.8	1.8
165	215	58	2.1	685 000	765 000	2 400	3 000	22224EAE4	22224EAKE4	132	142	203	190	2	0.25	3.9	2.7	2.6
	215	76	2.1	790 000	970 000	1 300	1 700	23224CAME4	23224CAMKE4	132	140	203	182	2	0.34	2.9	2.0	1.9
170	260	86	3	1 190 000	1 320 000	1 700	2 200	22324EAE4	22324EAKE4	134	157	246	222	2.5	0.32	3.1	2.1	2.0
	200	52	2	500 000	655 000	1 700	2 000	23026CAME4	23026CAMKE4	140	147	190	180	2	0.23	4.3	2.9	2.8
175	200	69	2	620 000	865 000	1 400	1 800	24026CAME4	24026CAMKE4	140	143	190	175	2	0.31	3.2	2.2	2.1
	210	64	2	630 000	825 000	1 300	1 700	23126CAME4	23126CAMKE4	140	149	200	184	2	0.28	3.6	2.4	2.4
180	210	80	2	735 000	1 010 000	1 300	1 700	24126CAME4	24126CAMKE4	140	146	200	180	2	0.37	2.7	1.8	1.8
	230	64	3	820 000	940 000	2 200	2 600	22226EAE4	22226EAKE4	144	152	216	204	2.5	0.26	3.8	2.6	2.5
185	230	80	3	875 000	1 080 000	1 200	1 600	23226CAME4	23226CAMKE4	144	150	216	196	2.5	0.34	2.9	2.0	1.9
	280	93	4	1 240 000	1 350 000	1 300	1 600	22326CAME4	22326CAMKE4	148	166	262	236	3	0.34	2.9	2.0	1.9

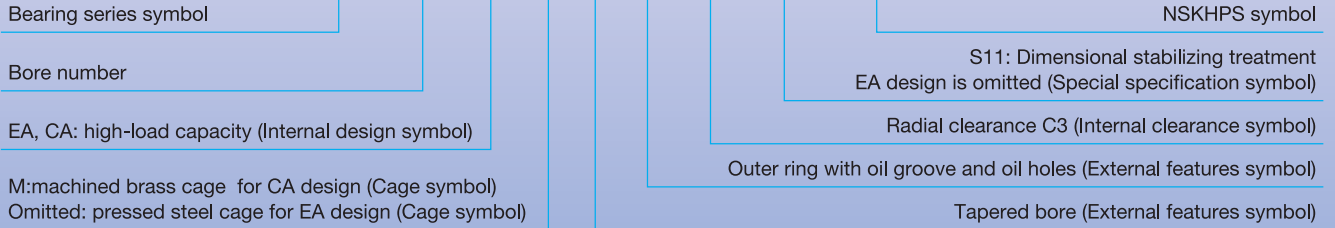
Note (°) The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Remarks 1. The maximum operating temperature of standard NSK HPS spherical roller bearings is 200°C.

2. The suffix E4 indicates that the bearing has an oil groove and holes

# Bearing Nomenclature

Example : **232 36 CA M K E4 C3 S11 \*H\***



Boundary dimensions (mm)				Basic load ratings (N)		Limiting speeds (min <sup>-1</sup> )		Bearing numbers		Abutment and fillet dimensions (mm)					Constant	Axial load factors		
<i>d</i>	<i>D</i>	<i>B</i>	<i>r</i> (min.)	<i>C<sub>r</sub></i>	<i>C<sub>0r</sub></i>	Grease	Oil	Cylindrical bore	Tapered bore (°)	<i>d</i> <sub>a</sub> (min.)	<i>d</i> <sub>a</sub> (max.)	<i>D</i> <sub>a</sub> (min.)	<i>D</i> <sub>a</sub> (max.)	<i>r</i> <sub>a</sub> (max.)	<i>e</i>	Y2	Y3	Y <sub>0</sub>
140	210	53	2	525 000	715 000	1 600	1 900	23028CAME4	23028CAMKE4	150	157	200	190	2	0.22	4.5	3.0	2.9
	210	69	2	655 000	945 000	1 300	1 700	24028CAME4	24028CAMKE4	150	154	200	186	2	0.31	3.2	2.1	2.1
	225	68	2.1	725 000	945 000	1 200	1 600	23128CAME4	23128CAMKE4	152	158	213	198	2	0.28	3.6	2.4	2.3
	225	85	2.1	835 000	1 160 000	1 200	1 600	24128CAME4	24128CAMKE4	152	156	213	192	2	0.37	2.7	1.8	1.8
	250	68	3	835 000	945 000	1 400	1 700	22228CAME4	22228CAMKE4	154	167	236	221	2.5	0.26	3.9	2.6	2.5
	250	88	3	1 040 000	1 300 000	1 100	1 500	23228CAME4	23228CAMKE4	154	163	236	213	2.5	0.35	2.9	1.9	1.9
	300	102	4	1 450 000	1 590 000	1 200	1 500	22328CAME4	22328CAMKE4	158	177	282	253	3	0.35	2.9	1.9	1.9
150	225	56	2.1	590 000	815 000	1 400	1 800	23030CAME4	23030CAMKE4	162	168	213	203	2	0.22	4.6	3.1	3.0
	225	75	2.1	740 000	1 090 000	1 200	1 500	24030CAME4	24030CAMKE4	162	165	213	198	2	0.30	3.4	2.3	2.2
	250	80	2.1	905 000	1 180 000	1 100	1 400	23130CAME4	23130CAMKE4	162	174	238	218	2	0.30	3.4	2.3	2.2
	250	100	2.1	1 070 000	1 450 000	1 100	1 400	24130CAME4	24130CAMKE4	162	169	238	212	2	0.38	2.6	1.8	1.7
	270	73	3	955 000	1 120 000	1 300	1 600	22230CAME4	22230CAMKE4	164	179	256	236	2.5	0.26	3.9	2.6	2.5
	270	96	3	1 220 000	1 560 000	1 100	1 400	23230CAME4	23230CAMKE4	164	176	256	230	2.5	0.35	2.9	1.9	1.9
	320	108	4	1 530 000	1 690 000	1 100	1 400	22330CAME4	22330CAMKE4	168	-	302	270	3	0.35	2.9	1.9	1.9
160	220	45	2	450 000	675 000	1 400	1 800	23932CAME4	23932CAMKE4	170	-	210	203	2	0.18	5.6	3.8	3.7
	240	60	2.1	675 000	955 000	1 300	1 700	23032CAME4	23032CAMKE4	172	179	228	216	2	0.22	4.5	3.0	2.9
	240	80	2.1	845 000	1 260 000	1 100	1 400	24032CAME4	24032CAMKE4	172	177	228	212	2	0.30	3.4	2.3	2.2
	270	86	2.1	1 070 000	1 400 000	1 000	1 300	23132CAME4	23132CAMKE4	172	185	258	234	2	0.30	3.4	2.3	2.2
	270	109	2.1	1 240 000	1 670 000	1 000	1 300	24132CAME4	24132CAMKE4	172	179	258	229	2	0.39	2.6	1.7	1.7
	290	80	3	1 140 000	1 320 000	1 200	1 500	22232CAME4	22232CAMKE4	174	190	276	255	2.5	0.26	3.8	2.6	2.5
	290	104	3	1 370 000	1 770 000	1 000	1 300	23232CAME4	23232CAMKE4	174	189	276	245	2.5	0.34	2.9	2.0	1.9
	340	114	4	1 700 000	1 900 000	1 100	1 300	22332CAME4	22332CAMKE4	178	-	322	287	3	0.35	2.9	1.9	1.9
170	230	45	2	440 000	660 000	1 400	1 800	23934BCAME4	23934BCAMKE4	180	-	220	213	2	0.17	5.8	3.9	3.8
	260	67	2.1	795 000	1 090 000	1 200	1 600	23034CAME4	23034CAMKE4	182	191	248	233	2	0.23	4.3	2.9	2.8
	260	90	2.1	1 030 000	1 520 000	1 000	1 300	24034CAME4	24034CAMKE4	182	188	248	228	2	0.31	3.2	2.2	2.1
	280	88	2.1	1 180 000	1 570 000	1 000	1 300	23134CAME4	23134CAMKE4	182	194	268	245	2	0.29	3.5	2.3	2.3
	280	109	2.1	1 280 000	1 770 000	1 000	1 300	24134CAME4	24134CAMKE4	182	190	268	239	2	0.38	2.7	1.8	1.7
	310	86	4	1 240 000	1 500 000	1 100	1 400	22234CAME4	22234CAMKE4	188	206	292	270	3	0.26	3.8	2.6	2.5
	310	110	4	1 500 000	1 910 000	900	1 200	23234CAME4	23234CAMKE4	188	201	292	261	3	0.35	2.9	1.9	1.9
	360	120	4	1 970 000	2 110 000	1 000	1 200	22334CAME4	22334CAMKE4	188	-	342	304	3	0.35	2.9	1.9	1.9
180	250	52	2	590 000	890 000	1 200	1 600	23936CAME4	23936CAMKE4	190	-	240	230	2	0.18	5.5	3.7	3.6
	280	74	2.1	935 000	1 270 000	1 200	1 400	23036CAME4	23036CAMKE4	192	202	268	249	2	0.24	4.2	2.8	2.8
	280	100	2.1	1 210 000	1 750 000	950	1 200	24036CAME4	24036CAMKE4	192	200	268	245	2	0.32	3.1	2.1	2.0
	300	96	3	1 320 000	1 760 000	900	1 200	23136CAME4	23136CAMKE4	194	206	286	260	2.5	0.31	3.3	2.2	2.2
	300	118	3	1 490 000	2 040 000	900	1 200	24136CAME4	24136CAMKE4	194	202	286	255	2.5	0.37	2.7	1.8	1.8
	320	86	4	1 280 000	1 540 000	1 100	1 300	22236CAME4	22236CAMKE4	198	212	302	278	3	0.26	3.9	2.6	2.6
	320	112	4	1 620 000	2 110 000	850	1 100	23236CAME4	23236CAMKE4	198	211	302	274	3	0.35	2.9	1.9	1.9
	380	126	4	2 170 000	2 340 000	950	1 200	22336CAME4	22336CAMKE4	198	-	362	322	3	0.34	2.9	2.0	1.9
190	260	52	2	575 000	875 000	1 200	1 500	23938CAME4	23938CAMKE4	200	-	250	240	2	0.18	5.7	3.8	3.7
	290	75	2.1	970 000	1 350 000	1 100	1 400	23038CAME4	23038CAMKE4	202	-	278	261	2	0.24	4.2	2.8	2.8
	290	100	2.1	1 220 000	1 840 000	900	1 200	24038CAME4	24038CAMKE4	202	210	278	253	2	0.32	3.1	2.1	2.0
	320	104	3	1 480 000	2 020 000	850	1 100	23138CAME4	23138CAMKE4	204	219	306	276	2.5	0.31	3.2	2.2	2.1
	320	128	3	1 630 000	2 240 000	850	1 100	24138CAME4	24138CAMKE4	204	211	306	269	2.5	0.38	2.6	1.8	1.7
	340	92	4	1 420 000	1 730 000	1 000	1 200	22238CAME4	22238CAMKE4	208	-	322	296	3	0.26	3.8	2.6	2.5
	340	120	4	1 800 000	2 350 000	800	1 100	23238CAME4	23238CAMKE4	208	222	322	288	3	0.35	2.8	1.9	1.9
	400	132	5	2 370 000	2 590 000	900	1 100	22338CAME4	22338CAMKE4	212	-	378	338	4	0.34	2.9	2.0	1.9
200	280	60	2.1	710 000	1 060 000	1 100	1 400	23940CAME4	23940CAMKE4	212	-	268	258	2	0.20	5.1	3.4	3.3
	310	82	2.1	1 180 000	1 700 000	1 000	1 300	23040CAME4	23040CAMKE4	212	-	298	279	2	0.25	4.0	2.7	2.6
	310	109	2.1	1 420 000	2 120 000	850	1 100	24040CAME4	24040CAMKE4	212	223	298	271	2	0.33	3.0	2.0	2.0
	340	112	3	1 700 000	2 330 000	800	1 000	23140CAME4	23140CAMKE4	214	232	326	293	2.5	0.32	3.2	2.1	2.1
	340	140	3	1 960 000	2 660 000	800	1 000	24140CAME4	24140CAMKE4	214	226	326	290	2.5	0.39	2.5	1.7	1.7
	360	98	4	1 620 000	2 010 000	950	1 200	22240CAME4	22240CAMKE4	218	-	342	315	3	0.26	3.8	2.6	2.5
	360	128	4	2 070 000	2 750 000	750	1 000	23240CAME4	23240CAMKE4	218	237	342	307	3	0.35	2.9	1.9	1.9
220	300	60	2.1	785 000	1 240 000	1 000	1 300	23944CAME4	23944CAMKE4	232	-	288	278	2	0.18	5.7	3.8	3.7
	340	90	3	1 360 000	1 980 000	950	1 200	23044CAME4	23044CAMKE4	234	-	326	302	2.5	0.24	4.1	2.8	2.7
	340	118	3	1 640 000	2 490 000	750	1 000	24044CAME4	24044CAMKE4	234	244	326	296	2.5	0.32	3.2	2.1	2.1
	370	120	4	1 960 000	2 710 000	710	950	23144CAME4	23144CAMKE4	238	254	352	320	3	0.31	3.2	2.1	2.1
	370	150	4	2 250 000	3 200 000	710	950	24144CAME4	24144CAMKE4	238	248	352	313	3	0.39	2.6	1.7	1.7
	400	108	4	1 960 000	2 430 000	850	1 000	22244CAME4	22244CAMKE4	238	260	382	348	3	0.27	3.7	2.5	2.4
	400	144	4	2 520 000	3 400 000	670	900	23244CAME4	23244CAMKE4	238	-	382	337	3	0.36	2.8	1.9	1.8
240	320	60	2.1	795 000	1 300 000	950	1 200	23948CAME4	23948CAMKE4	252	-	308	298	2	0.17	6.0	4.0	3.9
	360	92	3	1 450 000	2 140 000	850	1 100	23048CAME4	23048CAMKE4	254	-	346	324	2.5	0.24	4.2	2.8	2.7
	360	118	3	1 730 000	2 730 000	710	950	24048CAME4	24048CAMKE4	254	265	346	317	2.5	0.30	3.3	2.2	2.2
	400	128	4	2 230 000	3 100 000	670	850	23148CAME4	23148CAMKE4	258	275	382	347	3	0.31	3.3	2.2	2.2
	400	160	4	2 660 000	3 800 000	670	850	24148CAME4	24148CAMKE4	258	268	382	341	3	0.38	2.7	1.8	1.8
260	360	75	2.1	1 170 000	1 870 000	850	1 000	23952CAME4	23952CAMKE4	272	-	348	333	2	0.19	5.4	3.6	3.5



# Triple Ring Bearings

## Bearing Nomenclature

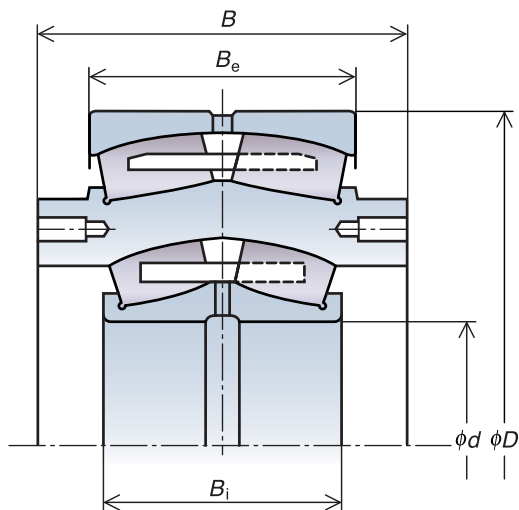
Example : **2SL 180-2 UPA**

Triple ring bearings  
(Spherical roller bearings)

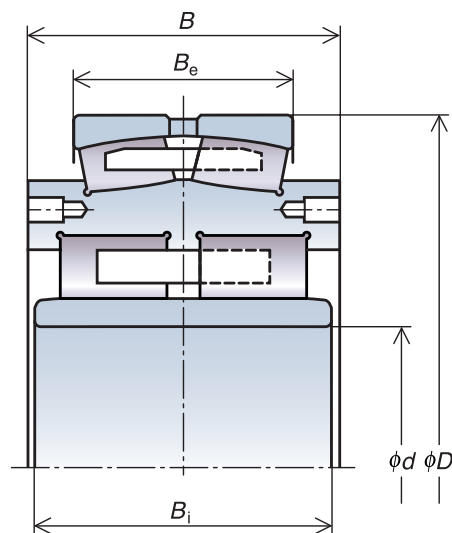
Bearing bore 180 mm

Special accuracy (Tolerance class symbol)

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 for Papermaking Machines

	TL Bearings
	NSKHPS Spherical Roller Bearings

Bore number	239		230		240		231		241		222		232		213		223	
	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS	TL	NSKHPS
05																		
06																		
07																		
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72																		
76																		
80																		
84																		
88																		
92																		
96																		
/500																		
/530																		
/560																		
/600																		
/630																		

# Radial Clearance in Spherical Roller Bearings with Tapered Bores

Bearings with tapered bores are directly mounted onto tapered shafts or onto cylindrical shafts with adapters or withdrawal sleeves (Fig. 1).

Large bearings are often mounted using hydraulic pressure. Fig. 2 shows a bearing mounting utilizing 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

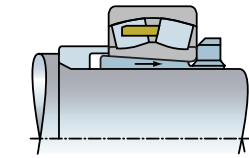


Fig. 1 Mounting with adapter

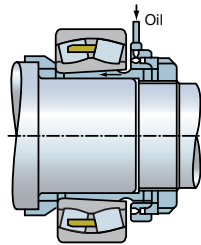


Fig. 2 Mounting with hydraulic nut

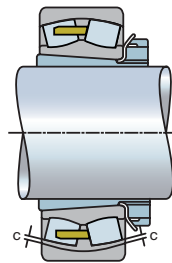


Fig. 3 Clearance measurement of spherical roller bearing

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.

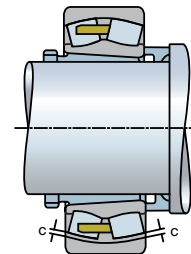
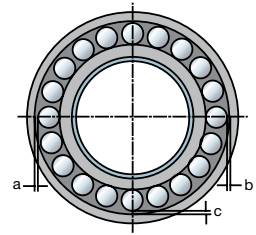


Fig. 4 Measuring clearance in large spherical roller bearing

Table 1 Radial Clearance in Spherical Roller Bearings with Tapered Bores

Unit: mm

Bearing bore diameter <i>d</i>		Clearance in bearings with tapered bores						Reduction in radial clearance		Axial movement				Minimum permissible residual clearance		
		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



# Bearing Maintenance and Inspection

## Maintenance

Bearings and operating conditions must be periodically inspected and maintained to maximize 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 analyzed by performing a quantitative analysis of vibration amplitude and frequency using a frequency spectrum analyzer. 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.

Table 1 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 raceways 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 countermeasures for papermaking machines



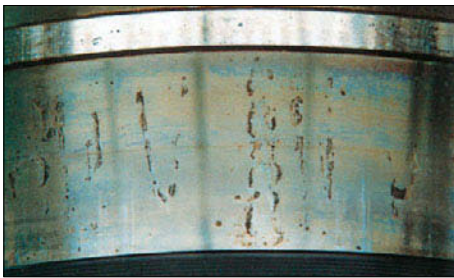
**Creep**

Bearing type	Application	Cause of damage	Measures
Tapered Roller Bearing	Press CC roll	<ul style="list-style-type: none"> <li>• Insufficient interference fit</li> </ul>	<ul style="list-style-type: none"> <li>• Tighten interference fit</li> </ul>
Spherical Roller Bearing	Dryer canvas roll	<ul style="list-style-type: none"> <li>• Dimensional variation at high temperatures</li> </ul>	<ul style="list-style-type: none"> <li>• Use TL steel</li> <li>• Use NSKHPS bearing</li> <li>• Apply high-temperature dimensional stabilizing treatment (S11)</li> </ul>



**Inner ring fracture**

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Dryer cylinder roll	<ul style="list-style-type: none"> <li>• Excessive force applied during mounting</li> <li>• Defective bore face contact</li> <li>• High hoop stress</li> </ul>	<ul style="list-style-type: none"> <li>• Control residual clearance</li> <li>• Adjust with taper gauge</li> <li>• Use TL steel</li> </ul>



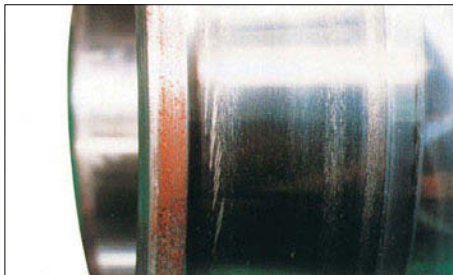
**Rust and corrosion**

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Wire suction roll	<ul style="list-style-type: none"> <li>• Insufficient oil film formation due to water entry</li> </ul>	<ul style="list-style-type: none"> <li>• Reinforce lubricating oil control</li> <li>• Improve bearing housing</li> <li>• Anti-rust treatment for idle periods</li> </ul>
	Press suction roll	<ul style="list-style-type: none"> <li>• Rust formed while stationary or being stored</li> </ul>	



### Flaking

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Wire suction roll	<ul style="list-style-type: none"> <li>• Insufficient oil film formation due to water entry</li> </ul>	<ul style="list-style-type: none"> <li>• Reinforce lubricating oil control</li> <li>• Improve bearing housing</li> </ul>
	Dryer cylinder roll	<ul style="list-style-type: none"> <li>• Insufficient oil film formation at high temperatures</li> </ul>	<ul style="list-style-type: none"> <li>• Use TL steel</li> <li>• Increase oil viscosity</li> <li>• Increase volume and reinforce control of lubricating oil temperature</li> <li>• Use thermal insulation sleeve</li> </ul>
	Dryer canvas roll	<ul style="list-style-type: none"> <li>• Excessive axial loading due to expansion of outer ring on the free-end bearing</li> </ul>	<ul style="list-style-type: none"> <li>• Use TL steel</li> <li>• Use NSKHPS bearing</li> <li>• Apply high temperature dimensional stabilizing treatment (S11)</li> </ul>



### Smearing

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Calender CC roll (triple ring)	<ul style="list-style-type: none"> <li>• Insufficient oil film formation</li> </ul>	<ul style="list-style-type: none"> <li>• Increase oil viscosity</li> <li>• Increase oil volume and reinforce control of lubricating oil temperature</li> <li>• Add additives to lubricating oil</li> </ul>



### Electrical corrosion

Bearing type	Application	Cause of damage	Measures
Deep Groove Ball Bearing Cylindrical Roller Bearing	Motor	<ul style="list-style-type: none"> <li>• Sparks produced by flow of current where rolling elements contact the raceway</li> </ul>	<ul style="list-style-type: none"> <li>• Design electric circuit which prevents current flow through the bearings</li> <li>• Insulate the bearing</li> </ul>



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