

NSK

SWR™ SERIES SPHERICAL ROLLER BEARINGS

WEAR-RESISTANT SOLUTIONS FOR CONTINUOUS CASTING MACHINES



STAY IN MOTION. STAY IN CONTROL.



MADE WITH METTLE

BEARINGS FOR STEEL AND METALS MACHINERY

Massive loads. Intense heat. Extreme high speeds, ultra-low speeds, and everything in between. Staggering shock loads, misalignment, and contamination from mill scale and water vapor. From primary iron and steel making through rolling and forming mills, the operating conditions of the entire process are severe. The reliable, uninterrupted performance of rolling components is critical for accelerated production. For NSK, our product development and design is focused squarely on withstanding the manifold operating stresses of these applications with:

- › increasing capacities for high loads and high speeds
- › advanced materials for durability, wear resistance and longer life
- › lubrication and seal technology for smooth and clean running

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

CONTINUOUS DURABILITY BY DESIGN

Spherical roller bearings used in guide rolls of continuous casting machines operate under extremely severe conditions and suffer from wear that would not normally occur under most other operating conditions.

Heavy loads at ultra-low speeds. Debris and water contamination. Roll bending stress. All of the ingredients for a short bearing life. In the worst cases, bearing fracture.

With extreme durability and core toughness, NSK SWR™ Spherical Roller Bearings are engineered to deliver superior resistance to wear and the onset of progressive bearing damage - promoting longer operating life and reducing unplanned maintenance downtime.



DESIGN AND OPERATING ADVANTAGES

NSK's SWR™ series spherical roller bearings are ideally designed for continuous casting machine applications, extending segment life and optimizing maintenance interval efficiencies with superior resistance to progressive wear and a longer operating life.



DESIGN FEATURES

- › Optimized, high capacity internal design
- › Outer rings manufactured with proprietary SWR steel composition and heat-treatment process
- › With wear-resistant surface treated pressed steel and heavy-duty machined brass cages
- › Dimensional series 213, 222, 223, 230, 231, 232, 240 and 241
- › For shaft diameters from 40 to 240 mm; additional series / sizes are available on request
- › Radial internal clearances C-normal, C3 and C4

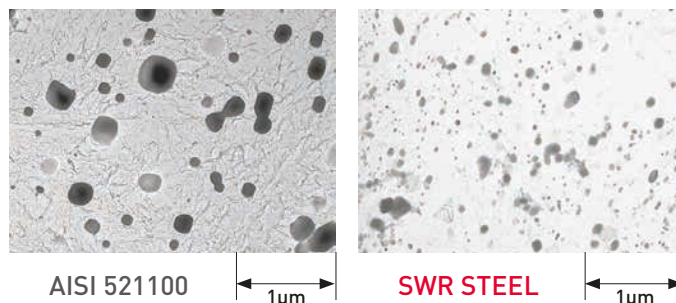
HIGH PERFORMANCE FACTOR: SWR STEEL

SWR™ Spherical Roller Bearings are the result of dedicated research efforts to extend bearing life through leading edge bearing material and heat treatment technologies. The outcome is an application-optimized solution that effectively contends with the unique operating challenges of continuous casting machines.

NSK utilizes carbide technology in conjunction with a special alloy to achieve our proprietary SWR bearing steel. Through advanced carbonitriding, precipitation of hard and fine-grained carbonitrides is attained - significantly finer than that found in conventional material such as AISI 52100 steel. Excellent wear resistance is achieved by consistent concentration in the material composition.

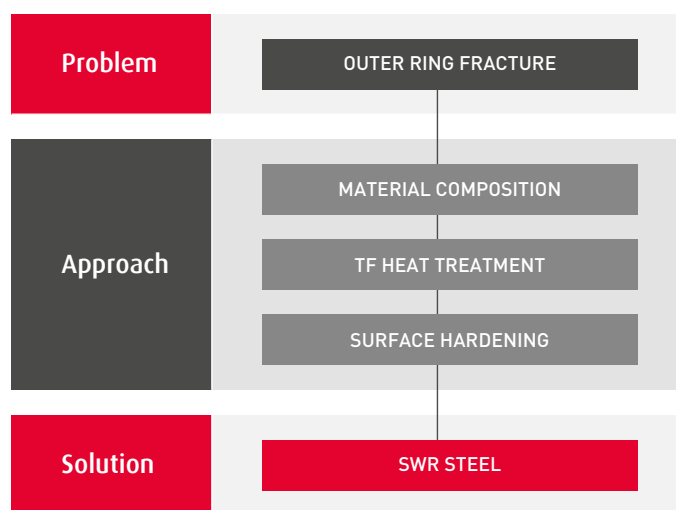
NSK Tough Steel (TF) heat-treatment technology is employed to optimize retained austenite in the material to reduce stress concentrations. This augments the wear resistance properties of the material with superior flaking life under contaminated lubrication conditions.

Finally, surface-hardening of SWR bearing steel dramatically increases core toughness, with considerably greater resistance to fracturing compared with through hardened conventional steel.



Microstructure: SWR v. AISI 52100

Material photos are the result of P-extraction replica work using transmission electron microscopy (TEM)



PROVEN ADVANTAGES

- › Superior wear resistance – 3 times that of conventional bearing steel
- › Improved flaking life property – 5 times that of conventional bearing steel
- › Higher toughness of material core (prevention of crack damage) – 5 times that of conventional bearing steel
- › Improved bearing durability extends segment roll operation, reducing maintenance costs and preventing unplanned downtime

BEARING FAILURE IN CONTINUOUS CASTING GUIDE ROLLS

IDENTIFICATION OF THE FAILURE MECHANISM

Spherical roller bearings for guide rolls operate under extreme conditions, and suffer from wear that would not otherwise occur. In the worst cases, bearings may even fracture.

The bearing operates at extremely low speed, suffering from the difficulty of drawing lubricant over the rolling contact surfaces. Matters are worsened by the entry of water and dust into the bearing interior. Wear occurs on the raceways due to differential slip of the rollers.

Stress concentration occurs at the pure rolling points with little wear, and surface originated flaking develops as a result.

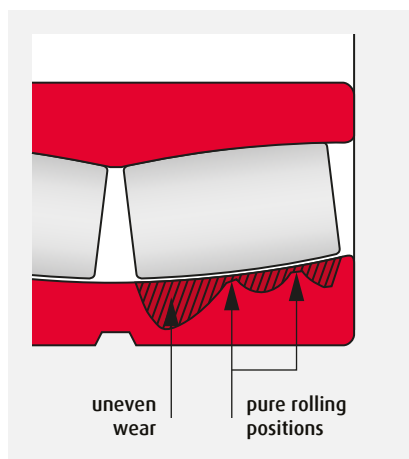
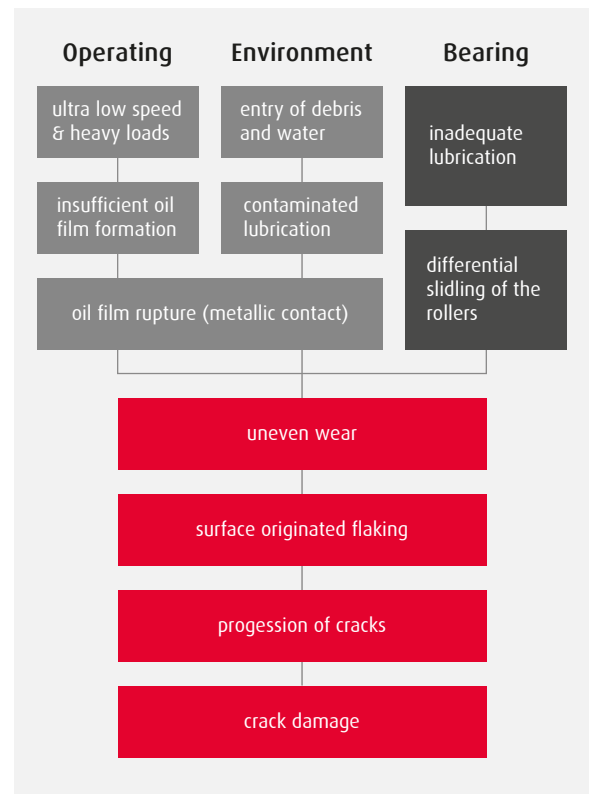
With increased flaking, vertical cracks are generated. Bending stresses acting on the outer ring propagates cracking to the point of fracture.



Pictured: outer ring wear

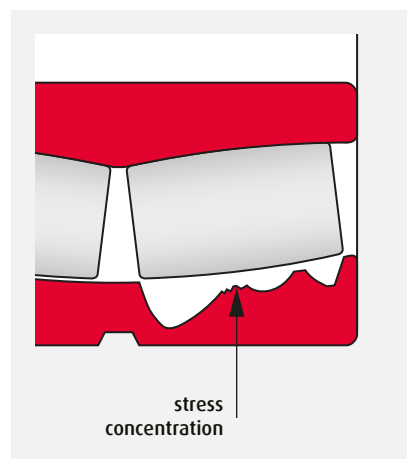


Pictured: outer ring flaking and crack damage.



UNEVEN WEAR

Caused by improper lubrication and differential sliding of the rollers



SURFACE ORIGINATED FLAKING

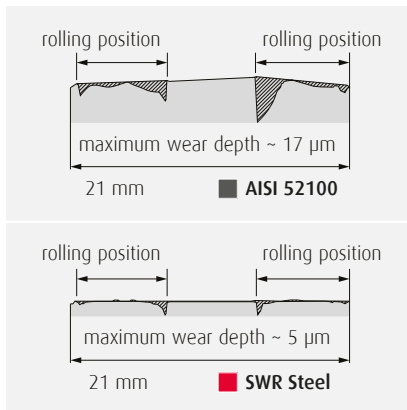
Due to stress concentration at the pure rolling positions with little wear



PROGRESSION OF CRACKS

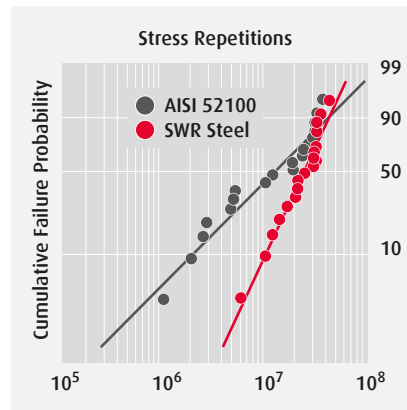
With fracture developing under the bending stress acting on the outer ring

IMPROVED WEAR RESISTANCE



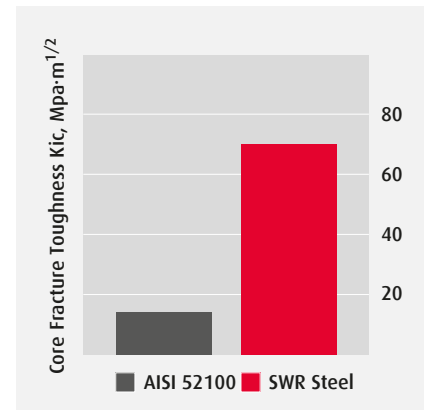
In durability testing conducted at ultra-low speed under water-infiltrated lubrication to simulate the environment of a continuous casting machine, SWR bearing steel demonstrates superior wear resistance – approximately three times that of conventional AISI 52100 steel.

IMPROVED FLAKING LIFE



When evaluating surface originated flaking under contaminated lubrication conditions using a thrust-type life tester, the high hardness achieved by carbonitriding and the reduced stress concentrations resulting from optimized retained austenite contribute to our SWR bearing steel demonstrating five times longer life than that of conventional steel.

IMPROVED CORE TOUGHNESS

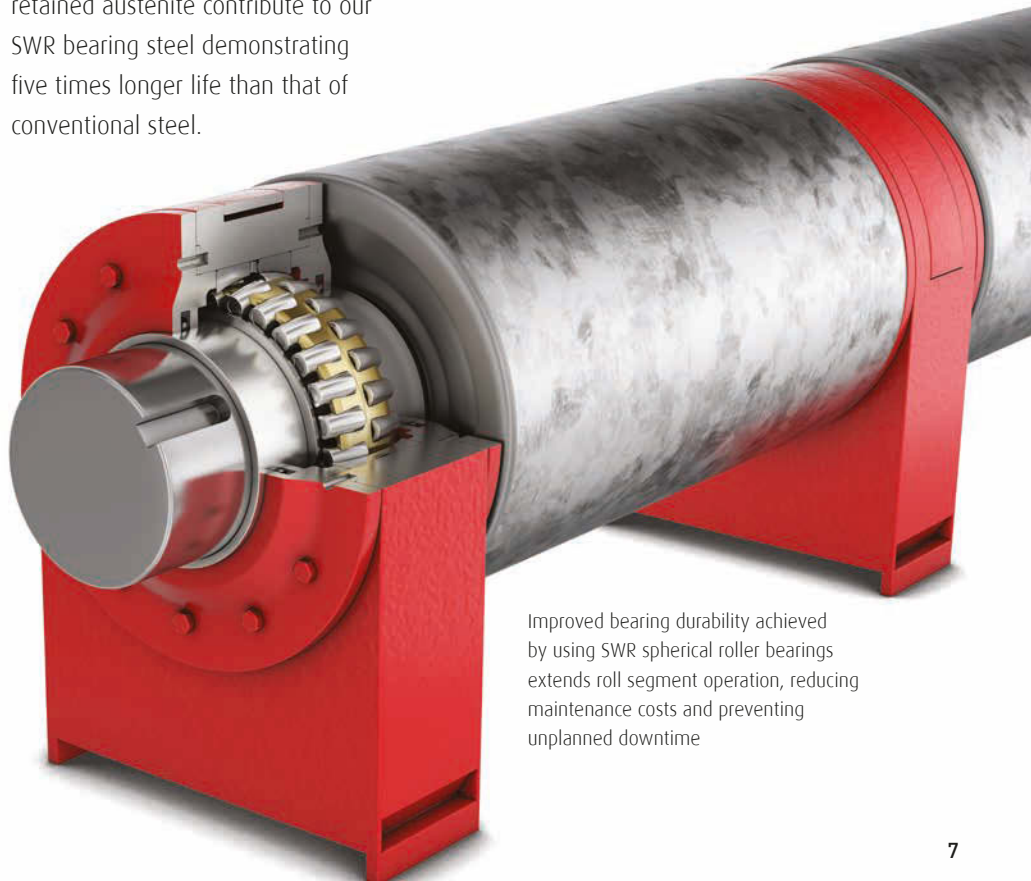


Results of core toughness tests show that fracture toughness derived from surface hardening of SWR bearing steel is five times that of conventional steel, making it more resistance to crack development and fracture.

3 TIMES
GREATER WEAR RESISTANCE

5 TIMES
LONGER FLAKING LIFE

5 TIMES
HIGHER CORE HARDNESS



Improved bearing durability achieved by using SWR spherical roller bearings extends roll segment operation, reducing maintenance costs and preventing unplanned downtime

THE REAL-WORLD IMPACT OF NSK OPTIMIZED BEARINGS

THE LOWER COSTS OF LONGER LIFE

Scheduled maintenance is prudent practice and an anticipated cost of business, but frequent and unplanned maintenance can have a devastating impact on productivity and the total cost of operation. With relentless pressure to accelerate production while simultaneously reducing cost-per-ton, successful producers look for greater machine efficiency and longevity in every process.

SWR™ spherical roller bearings allow users who have been burdened with replacing roll segments at frequent cycles to attain the benefits of extended uptime and reduced maintenance. They dramatically outperform and outlast conventional designs, mitigating unplanned maintenance and allowing rolls to operate to the full extent of their life.

Field Endurance Evaluation:

Average segment
replacement cycles: 1

Standard Spherical Roller Bearings

Average segment replacement cycles: 1.6

Maximum: 2

SWR Spherical Roller Bearings

Above: Typical ratio of extended segment replacement cycles in roller apron and pinch roll segments

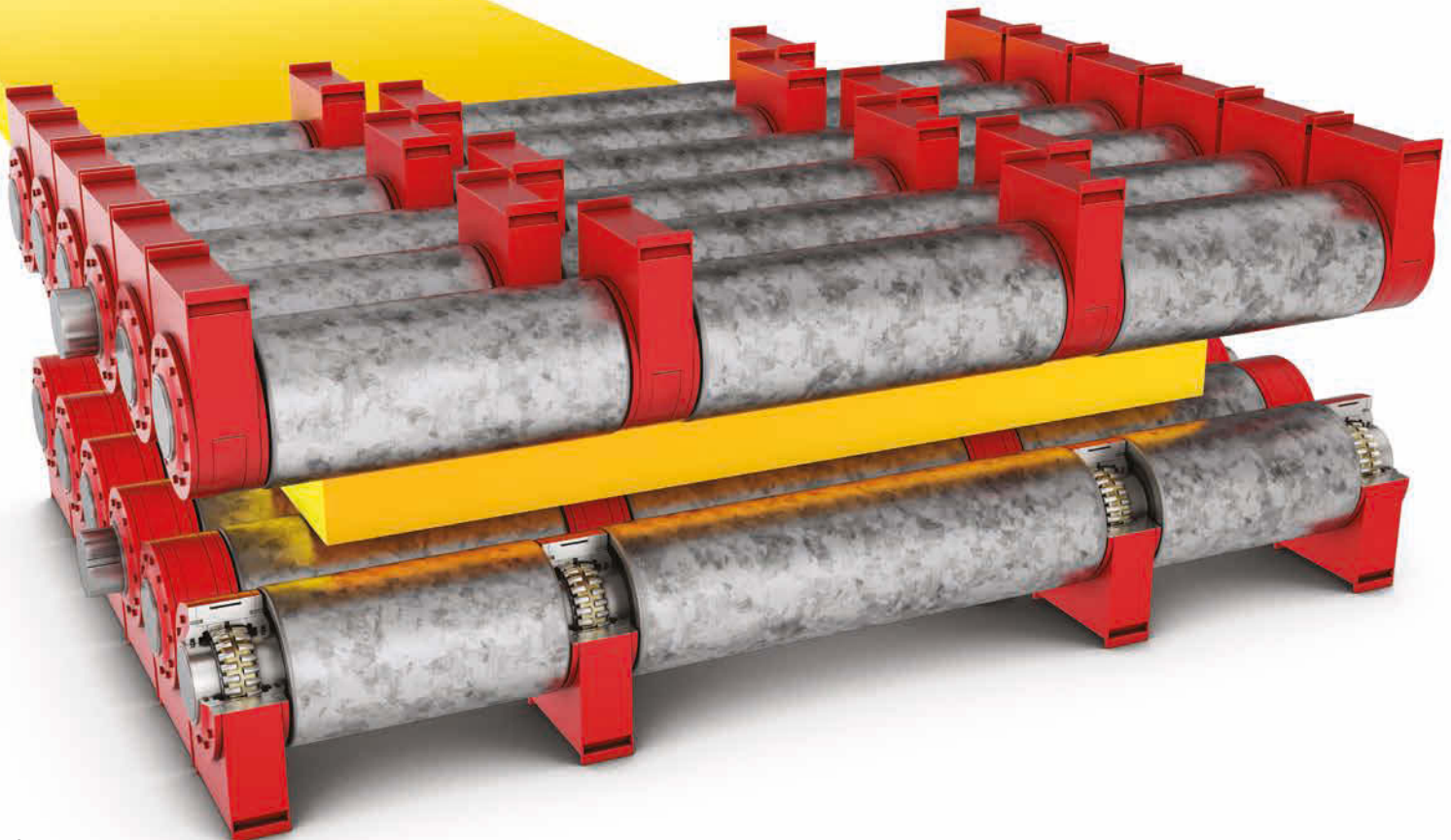


Fig. 1 - Bearing Arrangement For Single Rolls

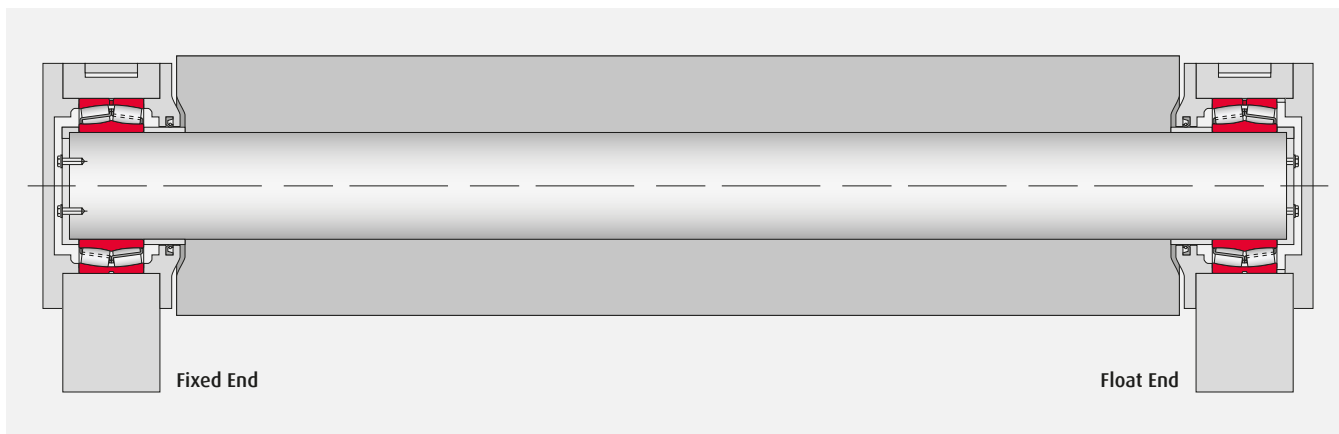


Fig. 2 - Bearing Arrangement For Combination Rolls

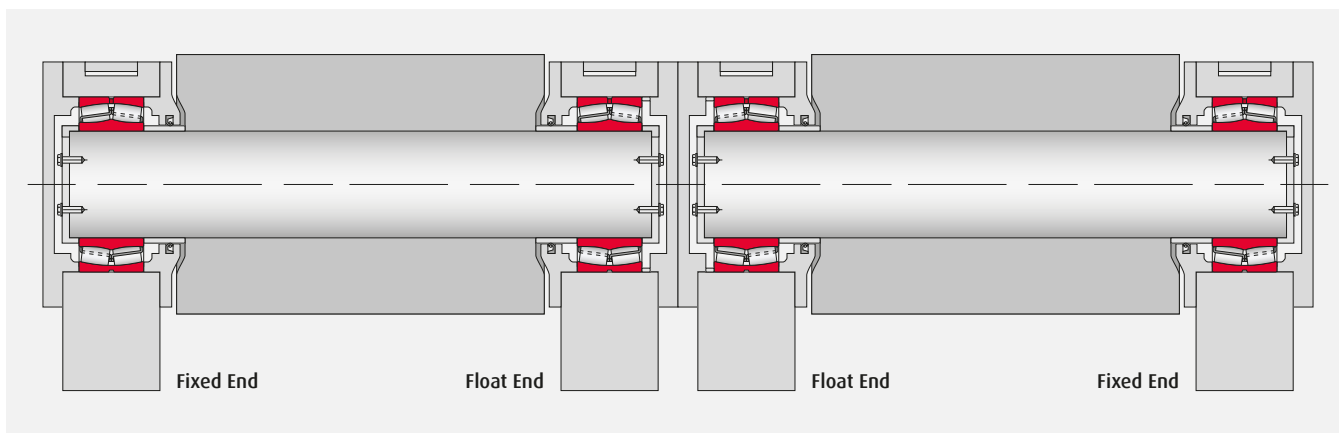
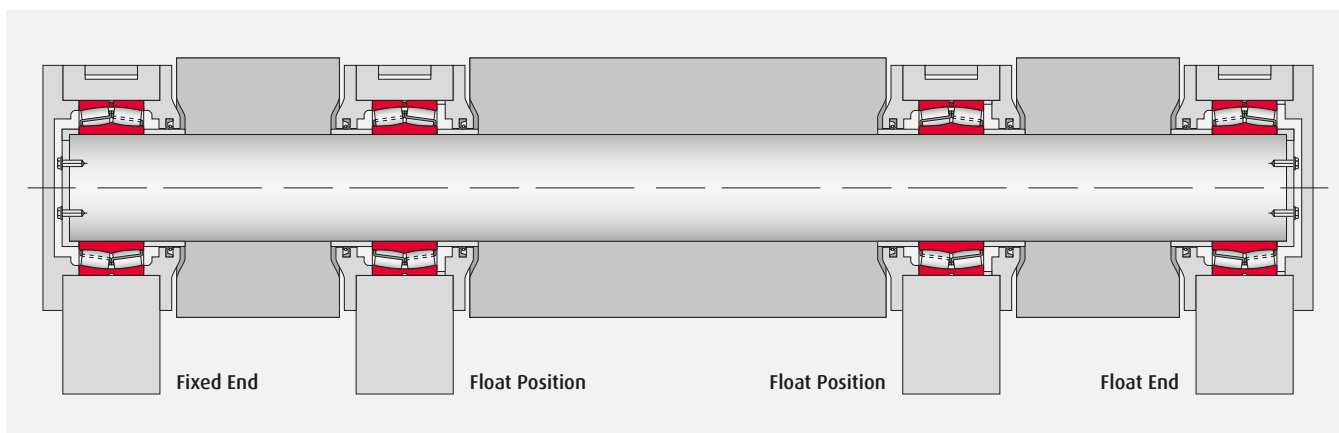
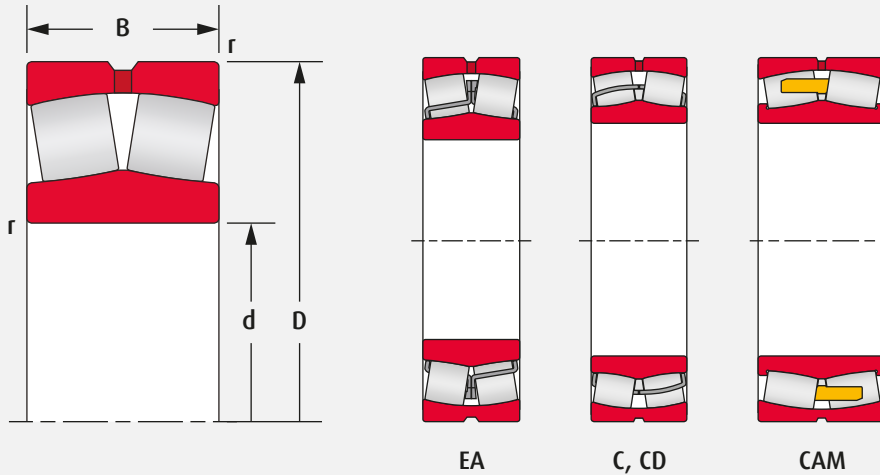


Fig. 3 - Bearing Arrangement For Segmented Rolls

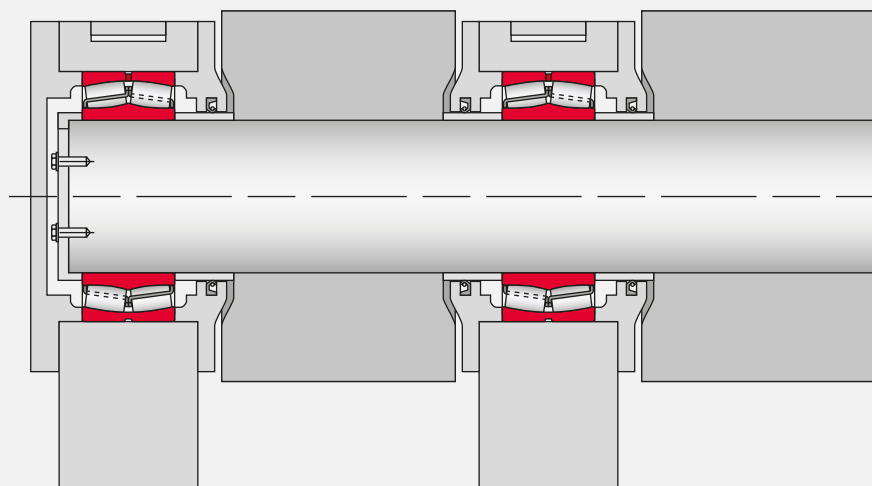


Additional and alternative bearing solutions are available for float positions; contact NSK.

BEARING DIMENSIONS AND OPERATING VALUES

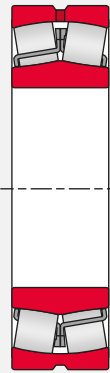
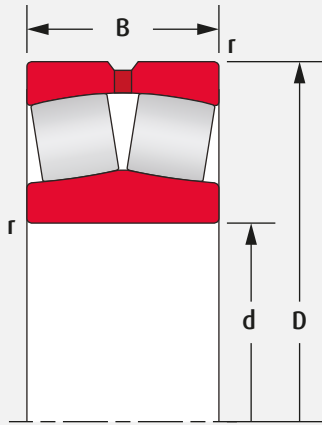


BASIC BEARING NO.	BEARING DIMENSIONS				BASIC LOAD RATINGS			
	mm				N		lbf	
	d	D	B	r (min)	Dynamic	Static	Dynamic	Static
22208SWREA	40	80	23	1.1	90 500	99 500	20 500	22 500
22308SWRCAM		90	33	1.5	136 000	153 000	30 500	34 500
22210SWREA	50	90	23	1.1	99 000	119 000	22 500	27 000
22211SWREA	55	100	25	1.5	119 000	144 000	27 000	32 500
21311SWREA		120	29	2.0	142 000	174 000	32 000	39 000
23012SWRC	60	95	26	1.1	98 500	141 000	22 000	31 500
22212SWREA		110	28	1.5	142 000	174 000	32 000	39 000
21312SWREA		130	31	2.1	190 000	244 000	42 500	55 000
22312SWRCAM		130	46	2.1	246 000	288 000	55 500	64 500
22213SWRCAM	65	120	31	1.5	152 000	190 000	34 000	42 500
22313SWRCAM		140	48	2.1	265 000	315 000	59 500	71 000
22214SWREA	70	125	31	1.5	225 000	232 000	50 500	52 000
22215SWREA	75	130	31	1.5	238 000	244 000	53 500	55 000
22216SWREA	80	140	33	2.0	264 000	275 000	59 500	62 000
21316SWREA		170	39	2.1	355 000	375 000	80 000	84 500
22316SWRCAM		170	58	2.1	390 000	480 000	87 500	108 000
22217SWREA	85	150	36	2.0	310 000	325 000	69 500	73 000
22218SWREA	90	160	40	2.0	360 000	395 000	81 000	89 000
23218SWRC		160	52.4	2.0	340 000	490 000	76 500	110 000
22318SWREA		190	64	3.0	665 000	705 000	149 500	158 500
22219SWRCAM	95	170	43	2.1	296 000	395 000	66 500	89 000



BASIC BEARING NO.	BEARING DIMENSIONS				BASIC LOAD RATINGS			
	mm				N		lbf	
	d	D	B	r (min)	Dynamic	Static	Dynamic	Static
23020SWRCD	100	150	37	1.5	212 000	335 000	47 500	75 500
24020SWRC		150	50	1.5	276 000	470 000	62 000	105 500
24120SWRCAM		165	65	2.0	345 000	535 000	77 500	120 500
22220SWREA		180	46	2.1	455 000	490 000	102 500	110 000
23022SWRCAM	110	170	45	2.0	293 000	465 000	66 000	104 500
24022SWRC		170	60	2.0	380 000	645 000	85 500	145 000
23122SWRCAM		180	56	2.0	480 000	630 000	108 000	141 500
24122SWRC		180	69	2.0	460 000	750 000	103 500	168 500
22222SWREA		200	53	2.1	605 000	645 000	136 000	145 000
23024SWRCAM	120	180	46	2.0	395 000	525 000	89 000	118 000
24024SWRCAM		180	60	2.0	480 000	680 000	108 000	153 000
24124SWRCAM		200	80	2.0	695 000	905 000	156 000	203 500
22224SWRCAM		215	58	2.1	490 000	690 000	110 000	155 000
23224SWRCAM		215	76	2.1	790 000	970 000	177 500	218 000
22324SWRCAM		260	86	3.0	845 000	1 120 000	190 000	252 000
23026SWRCD	130	200	52	2.0	400 000	655 000	90 000	147 000
24026SWRCAM		200	69	2.0	620 000	865 000	139 500	194 500
24126SWRCAM		210	80	2.0	590 000	1 010 000	132 500	227 000
22226SWREA		230	64	3.0	820 000	940 000	184 500	211 500
23226SWRCAM		230	80	3.0	875 000	1 080 000	196 500	243 000

BEARING DIMENSIONS AND OPERATING VALUES



EA

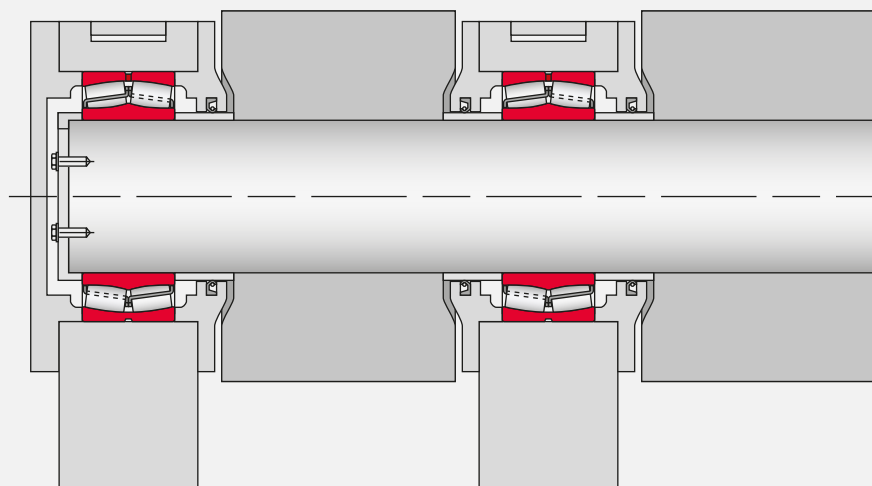


C, CD



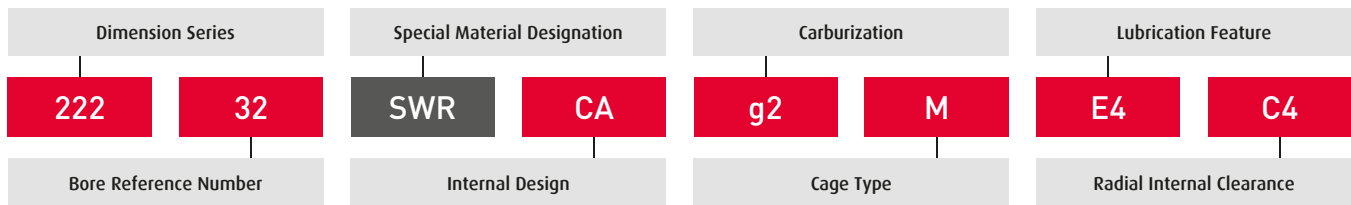
CAM

BASIC BEARING NO.	BEARING DIMENSIONS				BASIC LOAD RATINGS			
	mm				N		lbf	
	d	D	B	r (min)	Dynamic	Static	Dynamic	Static
23028SWRCD	140	210	53	2.0	420 000	715 000	94 500	160 500
24028SWRCAM		210	69	2.0	635 000	905 000	143 000	203 500
23128SWRCAM		225	68	2.1	725 000	945 000	163 000	212 500
24128SWRCAM		225	85	2.1	835 000	1 160 000	187 500	261 000
22228SWRCAM		250	68	3.0	835 000	945 000	187 500	212 500
23228SWRCAM		250	88	3.0	835 000	1 300 000	187 500	292 500
23030SWRCD	150	225	56	2.1	470 000	815 000	105 500	183 000
24030SWRCAM		225	75	2.1	740 000	1 090 000	166 500	245 000
23130SWRC		250	80	2.1	725 000	1 180 000	163 000	265 500
24130SWRC		250	100	2.1	890 000	1 530 000	200 000	344 000
22230SWRCD		270	73	3.0	765 000	1 129 000	172 000	254 000
23230SWRC		270	96	3.0	975 000	1 560 000	219 000	350 500
23032SWRCD	160	240	60	2.1	540 000	955 000	121 500	214 500
24032SWRCAM		240	80	2.1	845 000	1 260 000	190 000	283 500
24132SWRC		270	109	2.1	1 040 000	1 760 000	234 000	395 500
22232SWRCD		290	80	3.0	910 000	1 320 000	204 500	296 500
23034SWRCD	170	260	67	2.1	640 000	1 090 000	144 000	245 000
24034SWRC		260	90	2.1	825 000	1 520 000	185 500	341 500
23134SWRCAM		280	88	2.1	940 000	1 570 000	211 500	353 000
24134SWRC		280	109	2.1	1 080 000	1 860 000	243 000	418 000
22234SWRCD		310	86	4.0	990 000	1 500 000	222 500	337 000
23234SWRC		310	110	4.0	1 200 000	1 910 000	270 000	429 500



BASIC BEARING NO.	BEARING DIMENSIONS				BASIC LOAD RATINGS			
	mm				N		lbf	
	d	D	B	r (min)	Dynamic	Static	Dynamic	Static
23036SWRCD	180	280	74	2.1	750 000	1 270 000	168 500	285 500
24036SWRCAM		280	100	2.1	1 210 000	1 750 000	272 000	393 500
23136SWRCAM		300	96	3.0	1 320 000	1 760 000	296 500	395 500
24136SWRCAM		300	118	3.0	1 490 000	2 040 000	335 000	458 500
22236SWRCD		320	86	4.0	1 020 000	1 540 000	229 500	346 000
23038SWRCAM	190	290	75	2.1	970 000	1 350 000	218 000	303 500
24038SWRCAM		290	100	2.1	1 220 000	1 840 000	274 500	413 500
24138SWRCAM		320	128	3.0	1 710 000	2 330 000	384 500	524 000
22238SWRCAM		340	92	4.0	1 140 000	1 730 000	256 500	389 000
23238SWRC		340	120	4.0	1 440 000	2 350 000	323 500	528 500
23040SWRCAM	200	310	82	2.1	1 180 000	1 700 000	265 500	382 000
24040SWRCAM		310	109	2.1	1 420 000	2 120 000	319 000	476 500
24140SWRCAM		340	140	3.0	1 960 000	2 660 000	440 500	598 000
22240SWRCAM		360	98	4.0	1 300 000	2 010 000	292 500	452 000
23044SWRCAM	220	340	90	3.0	1 360 000	1 980 000	305 500	445 000
24044SWRCAM		340	118	3.0	1 310 000	2 490 000	294 500	560 000
24144SWRCAM		370	150	4.0	1 800 000	3 200 000	404 500	719 500
22244SWRCAM		400	108	4.0	1 570 000	2 430 000	353 000	546 500
23244SWRC		400	144	4.0	2 010 000	3 400 000	452 000	764 500
24048SWRCAM	240	360	118	3.0	1 730 000	2 730 000	389 000	613 500
24148SWRCAM		400	160	4.0	2 660 000	3 800 000	598 000	854 500

DESIGNATION SYSTEM



DESIGNATION		ATTRIBUTE
Dimensional Series	213	extra heavy duty type
	222	medium duty type
	223	heavy duty type
	230	very light duty type
	231	light duty type
	232	medium duty type, wide
	240	very light duty type, wide
	241	light duty type, wide
Bore Reference Number		multiply x 5 for bore diameter in mm; 500 mm and greater expressed with a "/" eg. /500 = 500 mm
Special Material Designation	SWR	Super Wear Resistant material technology
Internal Design	EA	high capacity design, steel cage
	CA	high capacity design, brass cage

DESIGNATION		ATTRIBUTE
Carburization	g	complete bearing
	g2	outer ring
	g5	inner and outer ring
Cage Type	blank	two piece steel cage
	CD	two piece steel cage with guide ring
	M	machined brass cage with guide ring
Lubrication Features	blank	no lubrication features
	E3	lubrication holes in the outer ring
	E4	lubrication groove and holes in the outer ring
Radial Internal Clearance	blank	normal clearance
	C3	greater than normal clearance
	C4	greater than C3



IMPROVEMENT PAYS

END-TO-END SERVICE DELIVERS CUSTOMER SUCCESS

Improvement never ends. And we never stop looking for better ways to support our customers in a complete, collaborative and continuous way. The focus of NSK isn't simply on a quick fix for immediate gain – it's about incremental and sustainable improvement to deliver long-term benefits. When NSK is on-site, we're there to understand our customers' challenges and identify problems contributing to frequent bearing replacement, breakdowns caused by poor specification, high energy costs from inefficient product selection and lost production because of downtime. We collaborate with our customers to institute an Asset Improvement Program (AIP) that encompasses process and maintenance management, diagnostic and educational support to deliver measurable gains in output and cost-efficiency. With NSK, our customers embark on a critical path to realizing improvements in equipment, productivity, people and financial performance.





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