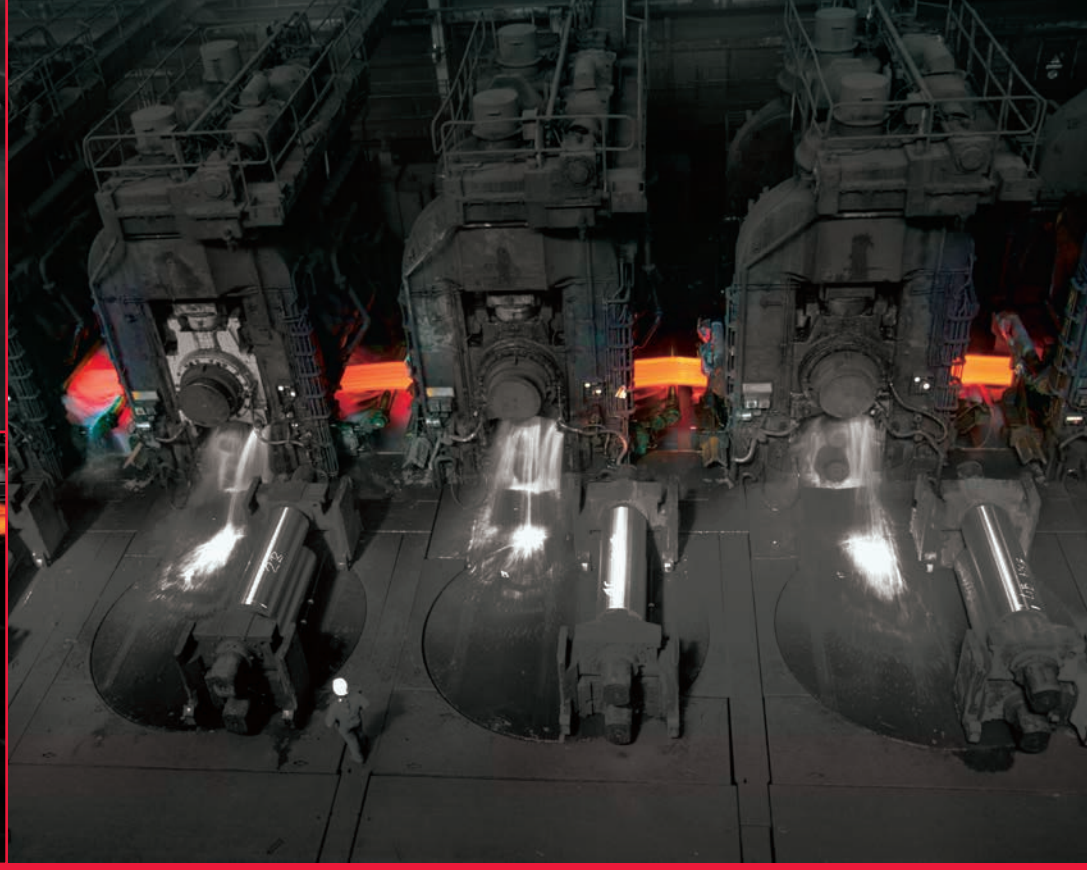
NSK

SEALED-CLEAN FOUR-ROW TAPERED ROLLER BEARINGS

EXTRA-CAPACITY WORK ROLL BEARINGS FOR ROLLING MILL STANDS

STAY IN MOTION. STAY IN CONTROL.



MADE WITH METTLE

BEARINGS FOR STEEL AND METALS MACHINERY

Massive loads. Intense heat. Ultra low speeds. Staggering shock loads, misalignment, and contamination from mill scale and water vapor.

From 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.

OUTSTANDING PERFORMANCE. ENGINEERED IN.

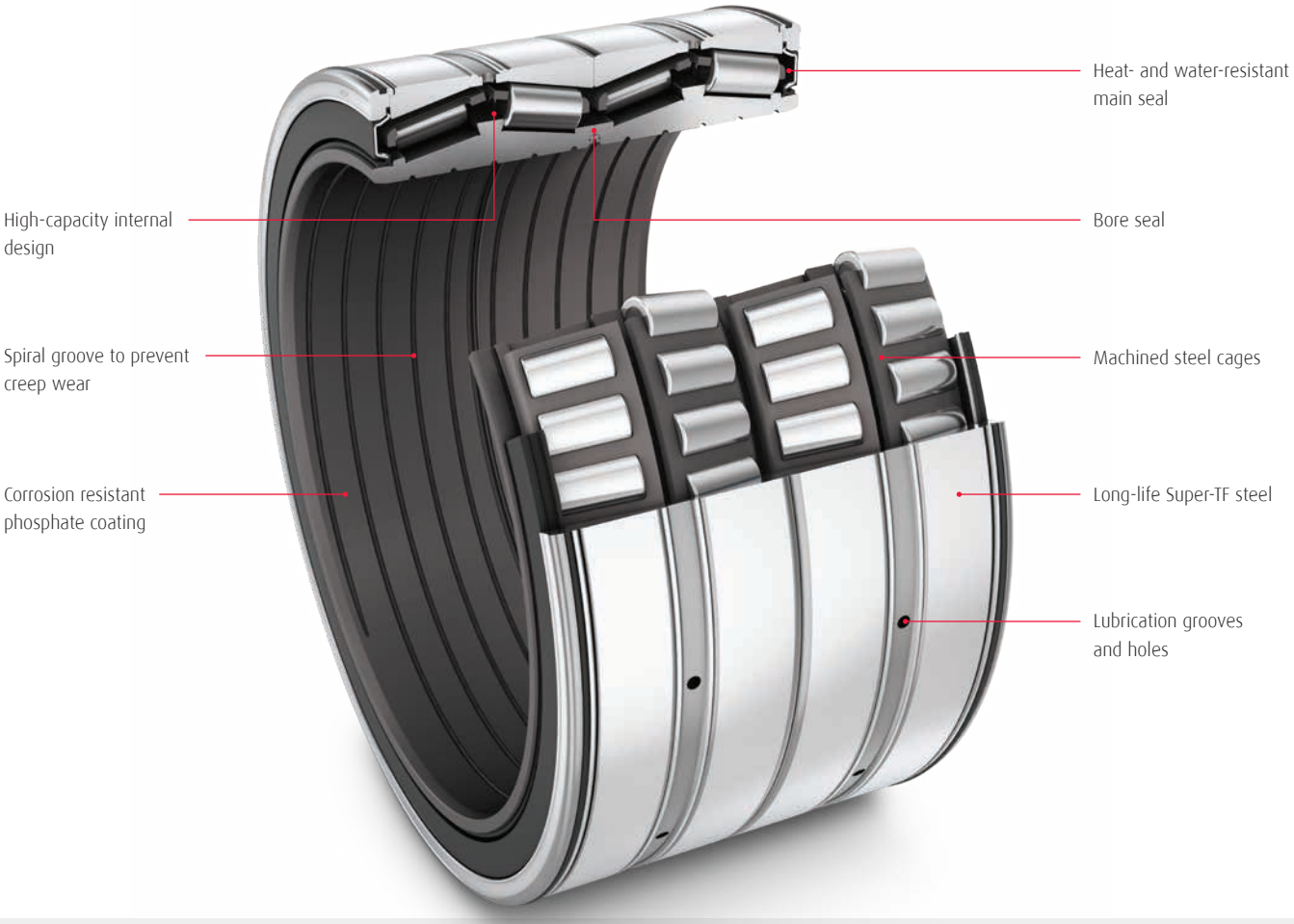
Four-row tapered roller bearings are engineered to withstand the heavy and impact loads transmitted - radially and axially - as passing steel is reduced in thickness by the work rolls in rolling mill stands. They must also accommodate wide speed variations including rapid acceleration and decelerations.

But arguably the most arduous challenges faced by these bearings are environmental: not only high temperatures, but also contending with mill scale contamination and water ingress.

NSK Extra-Capacity Sealed-Clean Tapered Roller Bearings are manufactured with long-life Super-TF steel to deliver significantly higher durability and wear resistance in contaminated lubrication conditions. And for utmost reliability and operating life amid aggressive environments, NSK's Sealed-Clean design offers improved heat- and water-resistant sealing protection, promoting reduced grease consumption and reduced maintenance costs.

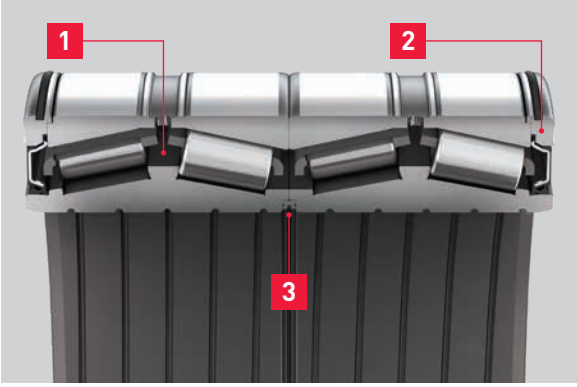
DESIGN AND OPERATING ADVANTAGES

NSK Extra-Capacity Sealed-Clean Four-Row Tapered Roller Bearings are engineered specifically to withstand the heavy and impact loads transmitted - radially and axially - in the work rolls of rolling mill stands, delivering reliability and productivity in the most aggressive environments.



DESIGN FEATURES

- Special design high capacity four-row tapered roller bearing
- With long-life Super-TF steel for dramatically longer service life under contaminated operating conditions
- With machined steel window- and pin-type cages
- Spiral groove on the inner ring bore to prevent creeping wear on the roll neck shaft
- Advanced heat- and water-resistant main seal design, with bore seal to control negative pressure during rolling to prevent water infiltration
- Corrosion resistant phosphate coating option for inner ring
- Outer ring lubrication grooves and holes
- With special radial and axial internal clearances
- Available in inch and metric design types



SEAL DESIGN MEASURES

1) High-load capacity design

New internal structure specifications are achieved with a compact main seal design, increasing bearing capacity

2) Main seal and holder

The heat- and water-resistant main seal and its holder makes handling easier and minimizes risk of seal damage

3) Bore seal

The bore seal prevents the build-up of negative pressure that can cause the entry of water through the main seals

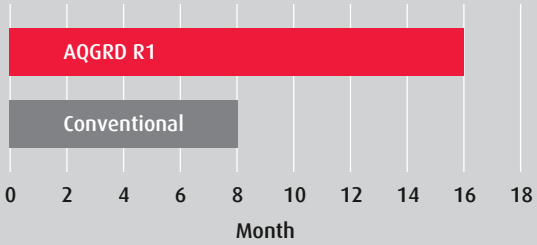
WATER-RESISTANT AQGRD R1 GREASE

Developed specifically for use with sealed-clean four-row tapered roller bearings, NSK long-life water-resistant grease (AQGRD R1) is elevated in base oil viscosity and special water-resistant additives.

Operating Benefits

- Inhibits water entry to rolling surface
- Minimizes premature flaking and rust
- More than doubles bearing flaking life versus conventional grease

Bearing service life in field test



Type of mill:
tandem cold rolling mill (4 high)

Bearing type:
sealed roll neck bearings KVS

Position:
work roll bearings

Bearing reference:
STF360KVS4801

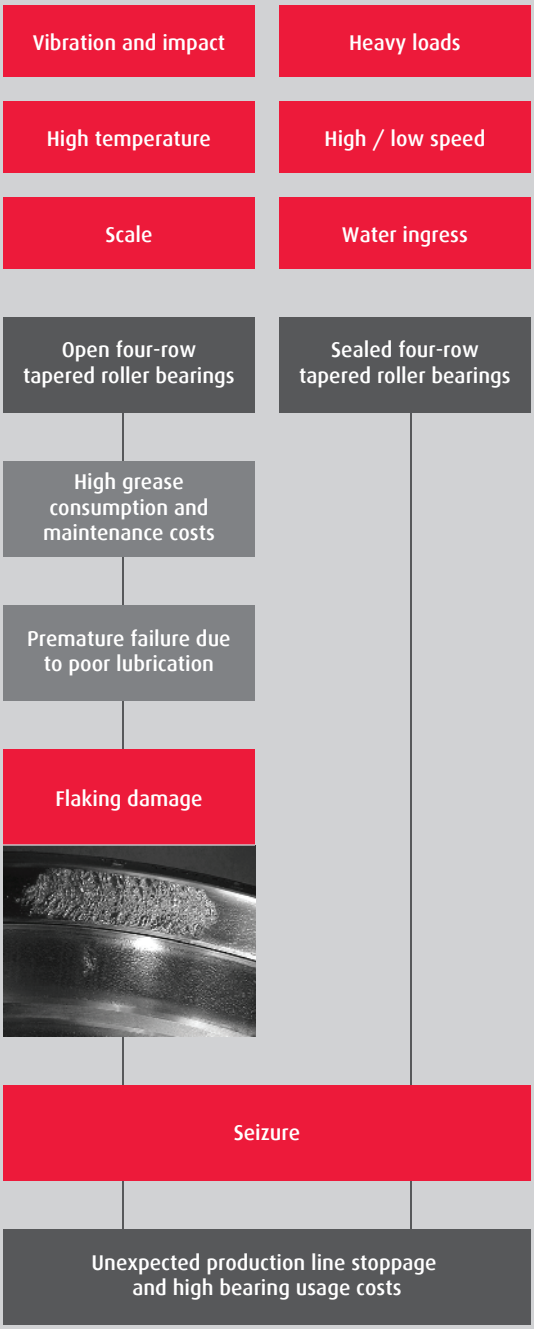
Facing water infiltration issues, NSK bearings lubricated with AQGRD grease demonstrated at least two times the life span of conventional sealed roll neck bearings, resulting in over 1 million tons of reliable steel output.

PROVEN ADVANTAGES

- Higher reliability and longer operating life with Super-TF steel, reducing bearing replacement and maintenance intervals
- Higher load capacity derived from optimized internal design, as much as 35% greater than conventional sealed bearings
- Sealed-clean solution extends bearing performance exponentially, significantly reducing grease consumption and corresponding maintenance costs / downtime
- Sealed bearings promote a cleaner work environment

HIGH PERFORMANCE SUPER-TF STEEL

FAILURE MECHANISMS IN WORK ROLLS



SUPER-TF (STF) MATERIAL TECHNOLOGY

Durability is crucial in work roll bearings in rolling mill stands. Four-row tapered roller bearings must endure heavy radial, axial and impact loads, high temperatures, high/low speeds and high contamination with reliable, uninterrupted performance to achieve and augment production capacities.

NSK's Super-TF (STF) series four-row tapered roller bearings are designed to deliver outstanding durability in these environments. Through advanced material engineering and heat treatment technology, they perform with superior resistance to wear, seizure and heat.

Material composition	Containing appropriate levels of chrome and molybdenum for increased hardness
Special heat-treatment	Optimized dispersion of finer carbide and carbonitride particles
Retained austenite	Alleviation of the stress concentration on the contact surface

In severe, contaminated, and boundary-lubrication conditions, Super-TF bearings optimize throughput, reduce maintenance intervals and deliver total cost-efficiency.

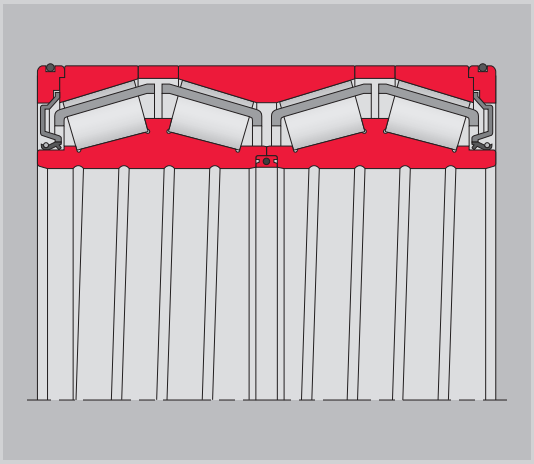
Life Test: Results under boundary lubrication (Δ=0.3)

1	General carburized steel
5.5	Super-TF steel

* ball-rod rolling contact fatigue test

HIGH PERFORMANCE SEAL DESIGN

OPTIMIZED SEALED-CLEAN DESIGN

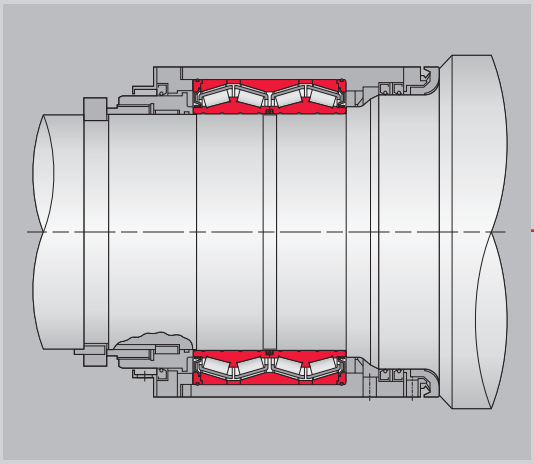


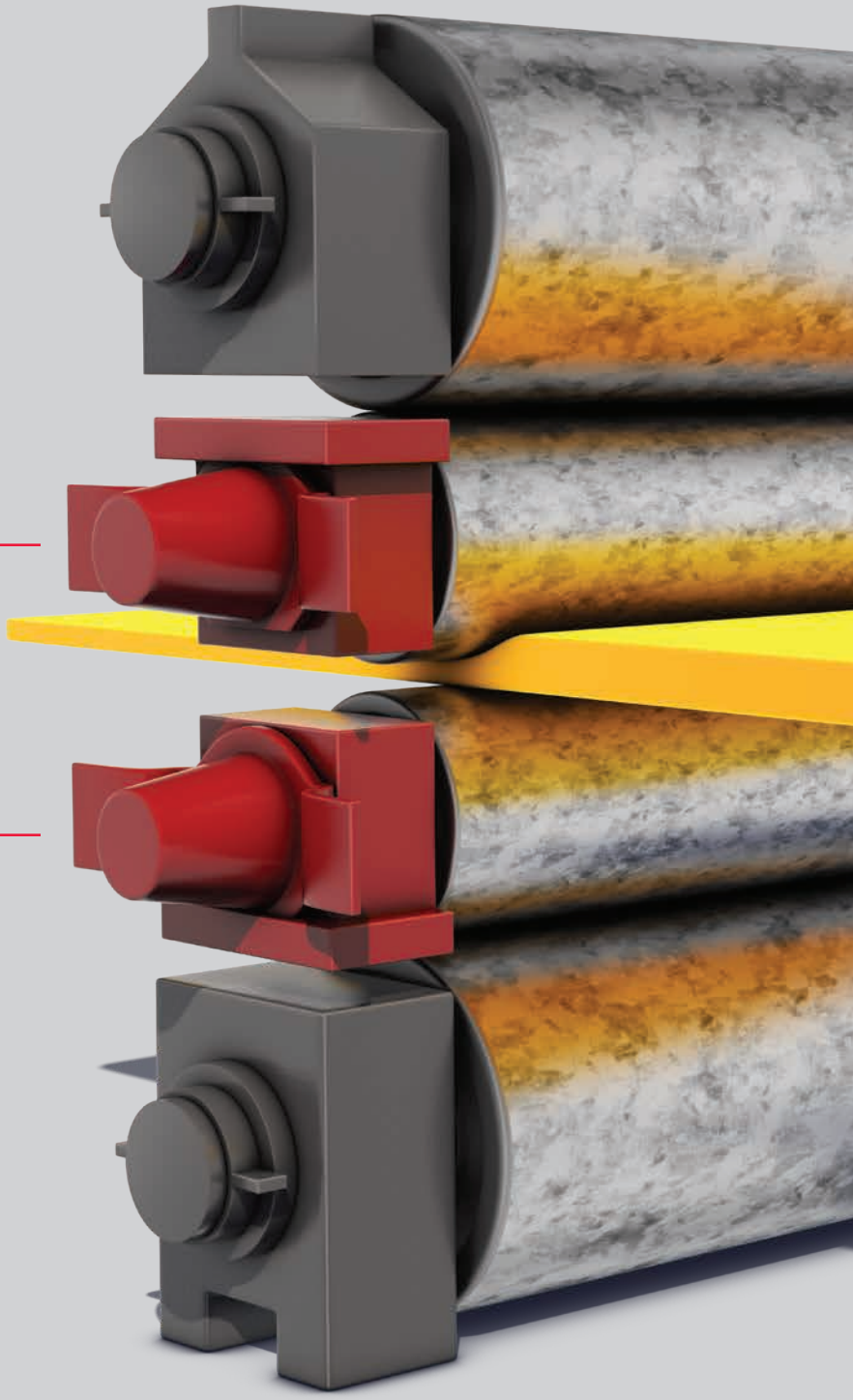
Basic load rating (C_r): 15-35% increase achieved with optimized internal design

Estimated life (L_{10}): 1.6 to 2.7 times of estimated life extension

Bearing seal performance: Negative pressure and water ingress have been reduced to less than 1/3

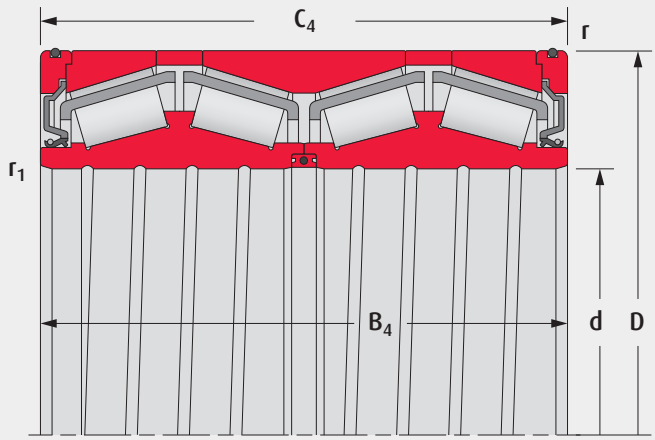
ARRANGEMENT FOR WORK ROLLS





Right: Tandem hot rolling stand, with work rolls in middle positions (with red chocks)

BEARING DIMENSIONS AND OPERATING VALUES

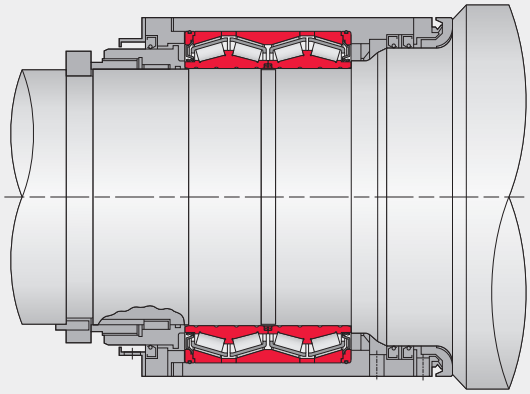


BASIC BEARING NO.	BEARING DIMENSIONS						BASIC LOAD RATINGS		CONSTANT	AXIAL LOAD FACTORS	
	mm						kN				
	d	D	B_4	C_4	r min	r_1 min	Dynamic	Static	e	Y_2	Y_3
STF215KVS2851Eg	215.9	288.925	177.8	177.8	3.3	0.8	1 070	2 350	0.49	2.1	1.4
STF216KVS3351Eg	216.103	330.2	263.525	269.875	3.3	1.5	2 290	4 550	0.46	2.2	1.5
STF220KVS3151Eg	220.662	314.325	239.712	239.712	3.3	1.5	1 960	4 350	0.33	3.0	2.0
STF228KVS3151Eg	228.6	311.15	200.025	200.025	3.3	1.5	1 560	3 500	0.33	3.0	2.0
STF234KVS3251Eg	234.95	327.025	196.85	196.85	3.3	1.5	1 550	3 200	0.46	2.2	1.5
STF241KVS3451Eg	241.478	349.148	228.6	228.6	3.3	1.5	2 020	4 150	0.35	2.9	1.9
STF244KVS3251Eg	244.475	327.025	193.68	193.68	3.0	1.5	1 370	3 050	0.40	2.5	1.7
STF254KVS3552Eg	254	358.775	269.875	269.875	3.3	1.5	2 420	5 500	0.40	2.5	1.7
STF260KVS3651Eg	260	365	340	340	4.0	2.5	2 960	7 350	0.40	2.5	1.7
STF260KVS4251Eg	260.35	422.275	314.325	317.5	3.3	6.4	3 600	7 050	0.33	3.0	2.0
STF266KVS3551Eg	266.7	355.6	230.188	228.6	3.3	1.5	1 960	4 600	0.35	2.9	1.9
STF276KVS3952Eg	276.225	393.7	269.875	269.875	3.3	1.5	2 720	6 100	0.45	2.2	1.5
STF279KVS3952Eg	279.4	393.7	269.875	269.875	6.4	1.5	2 720	6 100	0.45	2.2	1.5
STF279KVS3954Eg		393.7	320	320	6.4	1.5	3 100	7 350	0.40	2.5	1.7
STF304KVS4351Eg	304.648	438.048	280.99	279.4	3.3	3.3	3 100	6 750	0.45	2.2	1.5
STF304KVS4155Eg	304.8	419.1	269.875	269.875	6.4	1.5	2 850	6 550	0.33	3.0	2.0
STF304KVS4152Eg	304.902	412.648	266.7	266.7	3.3	1.5	2 760	6 500	0.33	3.0	2.0
STF317KVS4251Eg	317.5	422.275	269.875	269.875	3.3	1.5	2 740	6 750	0.34	3.0	2.0
STF317KVS4451Eg		447.675	367	367	3.0	3.6	3 850	9 500	0.33	3.0	2.0

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

Dynamic Equivalent Load: $P = XF_r + YF_a$
Static Equivalent Load: $P_0 = F_r + Y_0F_a$
Where: $Y_0 = Y_3$

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



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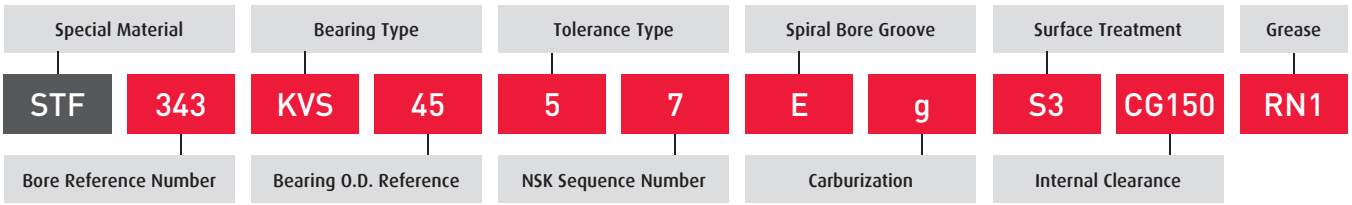
	mm						kN				
	d	D	B_4	C_4	r min	r_1 min	Dynamic	Static	e	Y_2	Y_3
STF343KVS4551Eg	340.052	457.098	254	254	3.3	1.5	2 830	6 700	0.45	2.2	1.5
STF355KVS4551Eg	355.6	457.2	252.412	252.412	3.3	1.5	2 650	6 750	0.32	3.2	2.1
STF355KVS4851Eg		482.6	265.112	269.875	3.3	1.5	3 100	7 200	0.47	2.1	1.4
STF374KVS5051Eg	374.65	501.65	250.825	260.35	3.3	1.0	2 970	7 150	0.47	2.1	1.4
STF384KVS5451Eg	384.175	546.1	400.05	400.05	6.4	3.3	5 250	12 400	0.33	3.1	2.1
STF385KVS5151Eg	385.762	514.35	317.5	317.5	3.3	3.3	4 150	10 400	0.33	3.0	2.0
STF406KVS5451Eg	406.4	546.1	288.925	288.925	6.4	1.5	3 950	9 450	0.48	2.1	1.4
STF406KVS5452Eg		546.1	330	330	6.4	1.0	4 350	11 000	0.48	2.1	1.4
STF406KVS5651Eg		562	381	381	6.4	3.3	4 950	11 900	0.33	3.0	2.0
STF409KVS5451Eg	409.575	546.1	334.962	334.962	6.4	1.5	4 500	11 700	0.40	2.5	1.7
STF457KVS5951Eg	457.2	596.9	276.225	279.4	3.3	1.5	4 000	9 850	0.47	2.2	1.4
STF482KVS6151Eg	482.6	615.95	330.2	330.2	6.4	4.3	4 900	13 500	0.33	3.1	2.1
STF489KVS6351Eg	489.026	634.873	320.675	320.675	3.3	3.3	4 850	12 500	0.38	2.7	1.8
STF558KVS7353Eg	558.8	736.6	455.6	457.2	6.4	3.3	8 300	23 000	0.35	2.9	2.0
STF585KVS7751Eg	585.788	711.525	479.425	479.425	6.4	3.0	8 250	22 700	0.33	3.0	2.0
STF660KVS8151Eg	660.4	812.8	365.125	365.125	6.4	3.3	6 050	17 700	0.33	3.0	2.0
STF708KVS9351Eg	708.025	930.275	565.15	565.15	6.4	3.3	12 000	34 000	0.33	3.0	2.0

Extra-Capacity Sealed-Clean Four-Row Tapered Roller Bearings are manufactured with NSK Super-TF material as the standard specification.
Bearings shown are inch dimension. Additional bearing designs / sizes - including open bearings and metric dimensions - are available. Please contact NSK for additional information.

DESIGNATION SYSTEM

FOUR-ROW TAPERED ROLLER BEARINGS



DESIGNATION		ATTRIBUTE
Special Material Designation	blank	standard bearing steel
	STF	long-life Super-TF™ steel
Bore Reference Number		bearing bore diameter expressed in mm eg. "343" = 343 - 343.999 mm
Bearing Type	KV	4-row tapered roller bearing
	KVS	sealed 4-row tapered roller bearing
Bearing O.D. Reference		multiply by 10 for bearing outer diameter within a 10 mm range eg. "45" = 450 - 459.999 mm
Tolerance Type	0 - 4	metric
	5 - 9	inch
Sequence Number	1 - 9	internal - assigned by NSK

DESIGNATION		ATTRIBUTE
Spiral Bore Groove	blank	no spiral groove
	E	with spiral groove
Carburization	g	entire bearing
Surface Treatment	S3	corrosion resistant phosphate coating on inner ring only
Internal Clearance	CGXXX	custom radial clearance, in microns
	CAXXX	custom axial clearance, in microns
	C3	greater than normal clearance
	C4	greater than C3 clearance
Grease		as specified, for sealed types only

IMPROVEMENT PAYS

END-TO-END SERVICE DELIVERS CUSTOMER SUCCESS

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

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

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

aip
NSK experts

NSK

NSK AMERICAS

United States
NSK Corporation
Ann Arbor MI
1.888.446.5675

Canada
NSK Canada Inc.
Mississauga ON
1.888.603.7667

Mexico
NSK Rodamientos Mexicana,
S.A. de C.V.
Silao Guanajuato MX
52.472.500.9500

Brazil
NSK Brasil Ltda.
Suzano SP
55.11.4744.2500

Argentina
NSK Argentina SRL
Buenos Aires
54.11.4704.5100

Latin America
NSK Latin America Inc.
Miramar FL
1.305.477.0605

Website: www.nskamericas.com
NSK Global: www.nsk.com

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