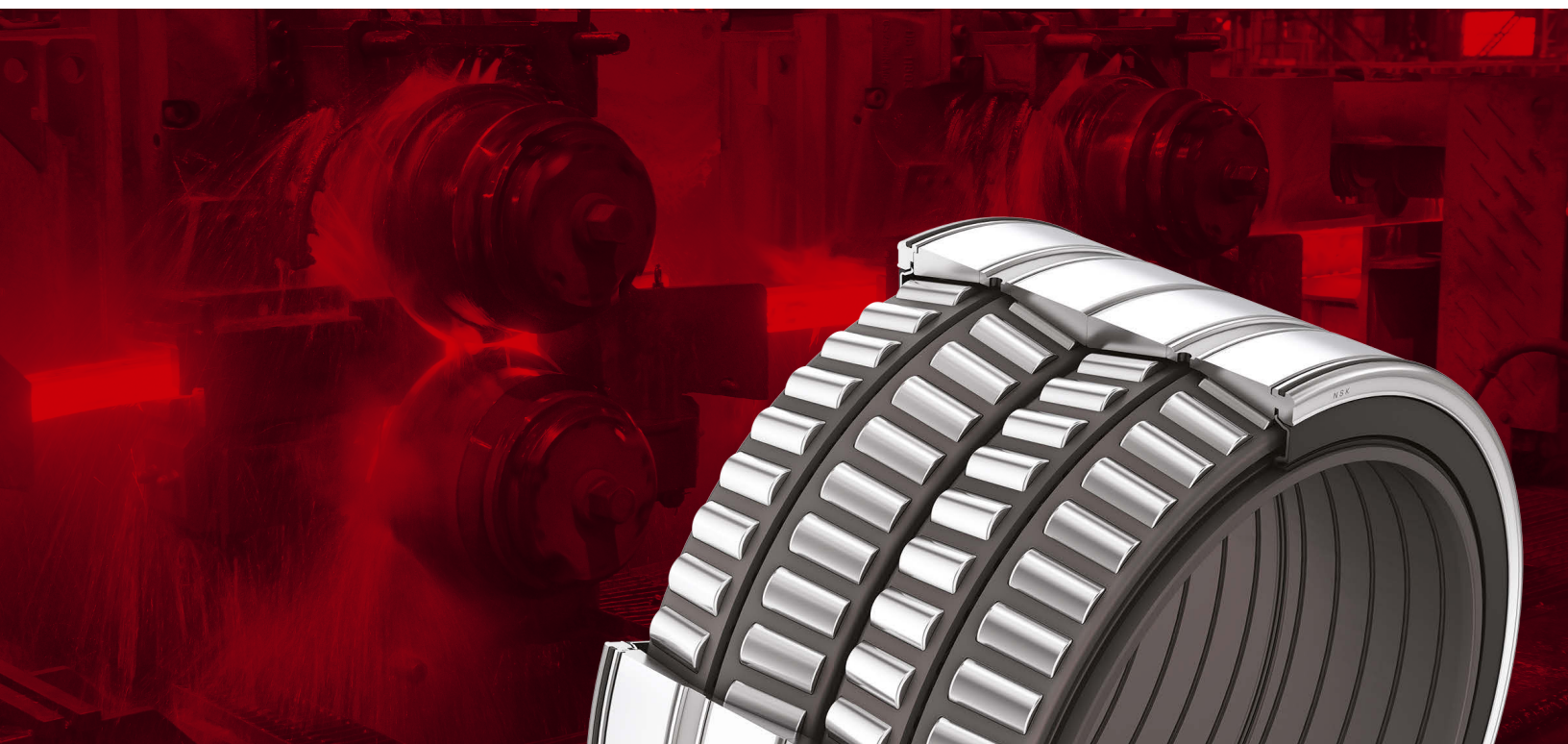


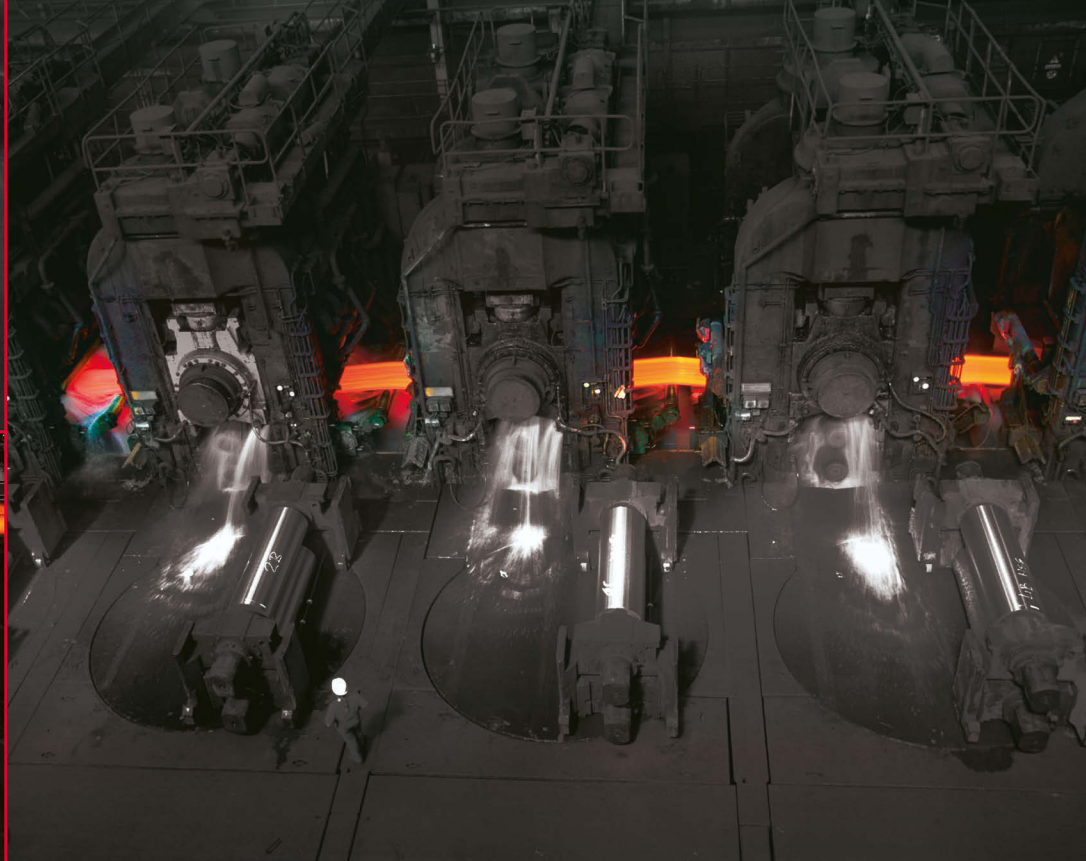


## SEALED-CLEAN FOUR-ROW TAPERED ROLLER BEARINGS

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.

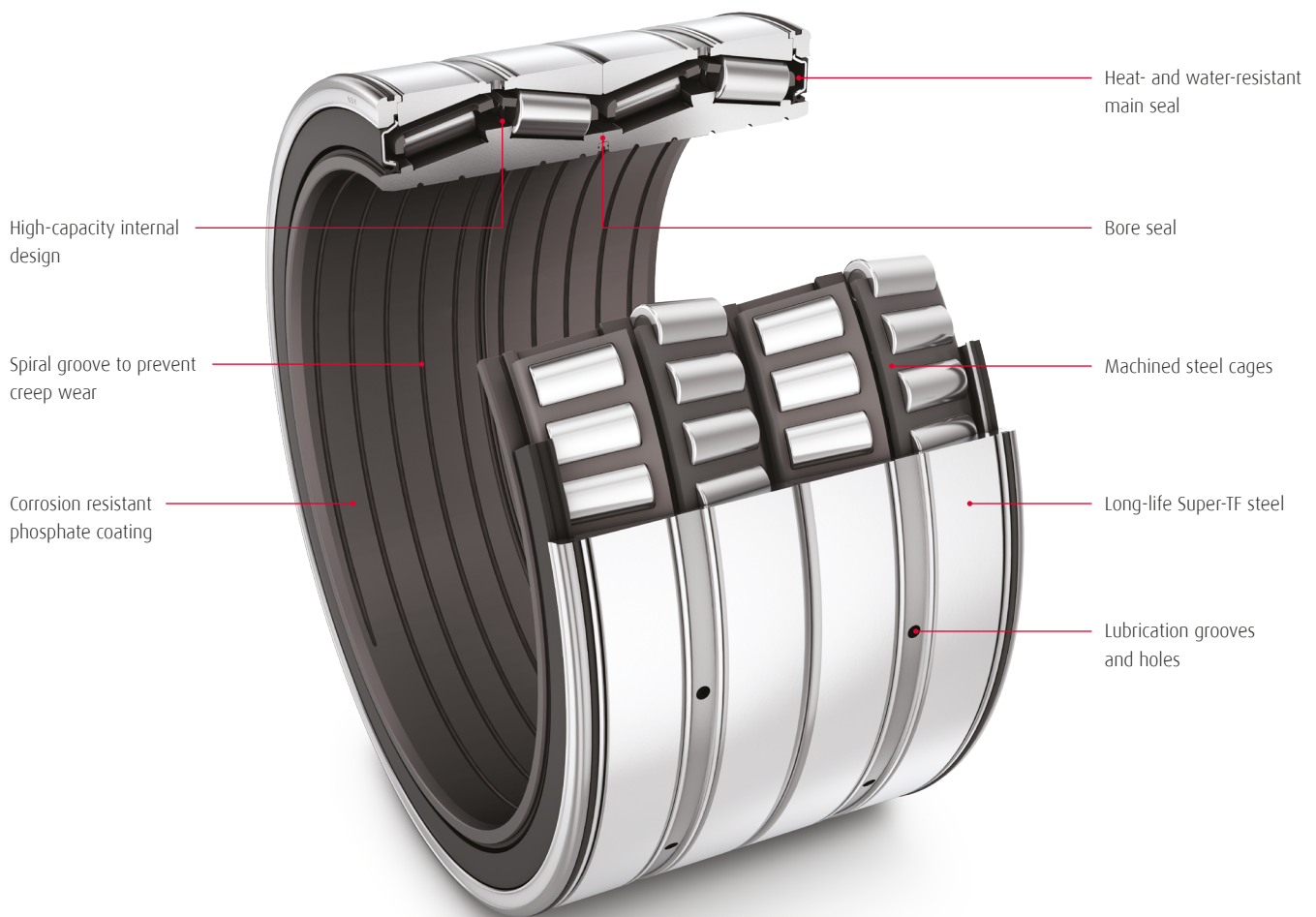
But arguably the most arduous challenges faced by these bearings are environmental: not only high temperatures, but also contending with mill scale contamination and water ingress.

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.



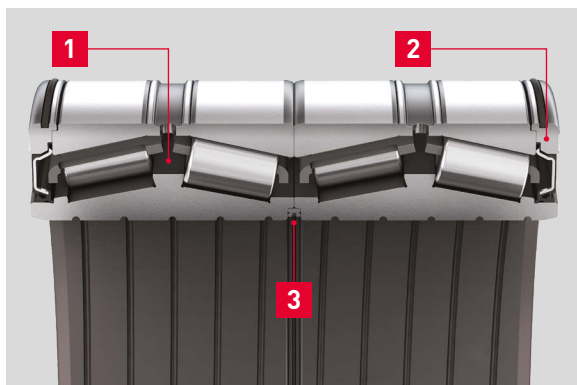
# DESIGN AND OPERATING ADVANTAGES

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

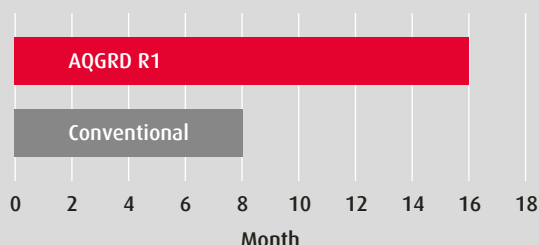
Developed specifically for use with sealed-clean four-row tapered roller bearings, NSK long-life water-resistant grease (AQGRD R1) is elevated in base oil viscosity and special water-resistant additives.

### 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                |

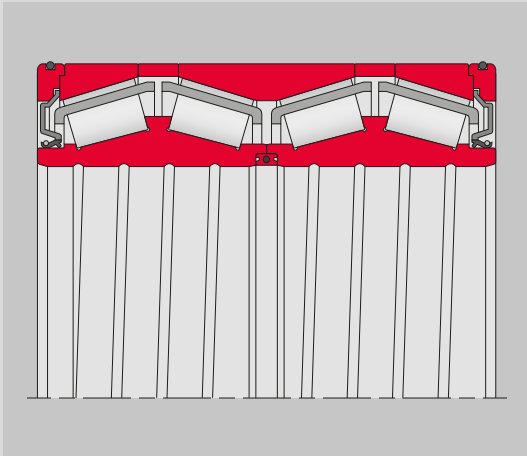
In severe, contaminated, and boundary-lubrication conditions, Super-TF bearings optimize throughput, reduce maintenance intervals and deliver total cost-efficiency.

### Life Test: Results under boundary lubrication ( $\Delta=0.3$ )

|     |                          |
|-----|--------------------------|
| 1   | General carburized steel |
| 5.5 | Super-TF steel           |

\* ball-rod rolling contact fatigue test

## OPTIMIZED SEALED-CLEAN DESIGN

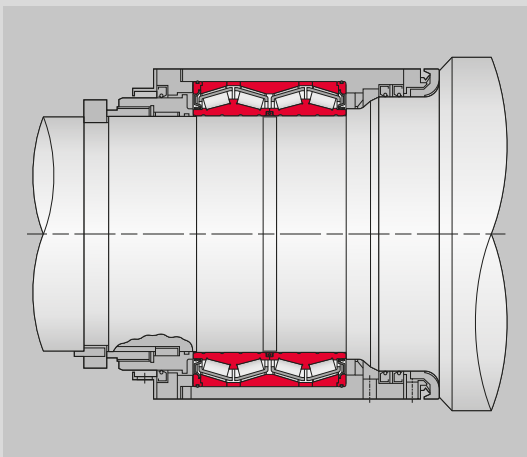


**Basic load rating ( $C_r$ ):** 15-35% increase achieved with optimized internal design

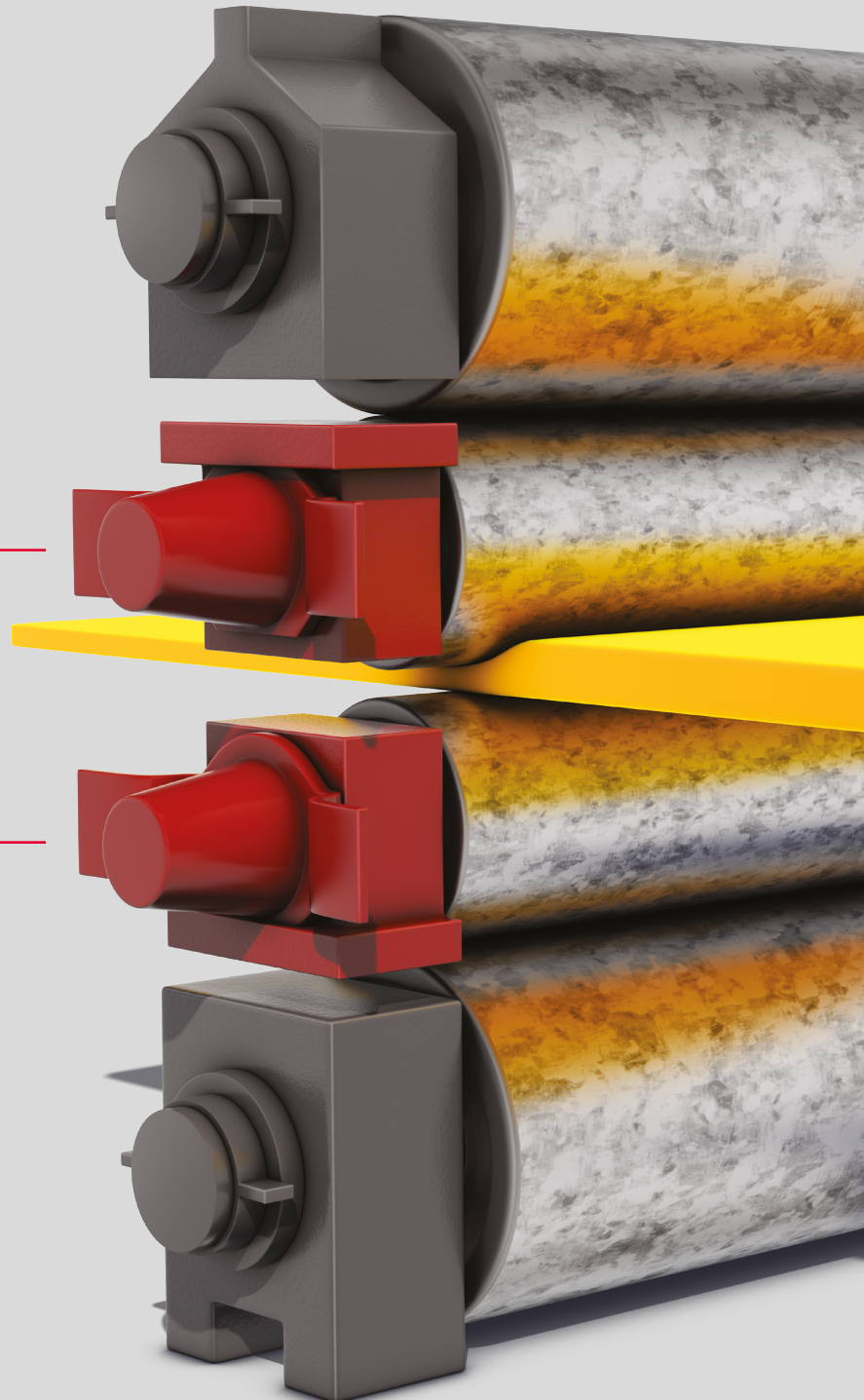
**Estimated life ( $L_{10}$ ):** 1.6 to 2.7 times of estimated life extension

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

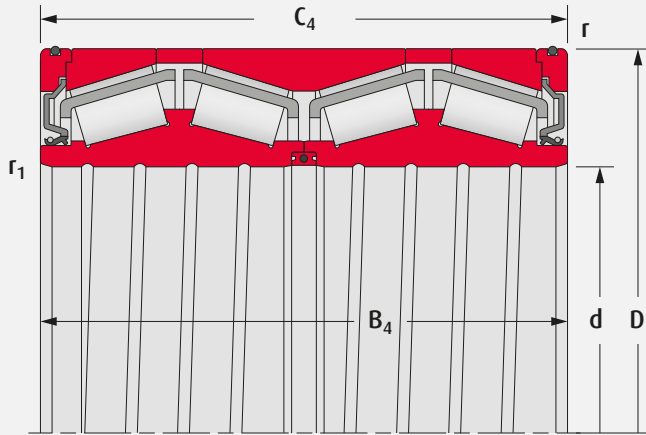
## ARRANGEMENT FOR WORK ROLLS



**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 <sub>4</sub> | C <sub>4</sub> | r min | r <sub>1</sub> min | Dynamic            | Static |          |                    |     |
| 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 |

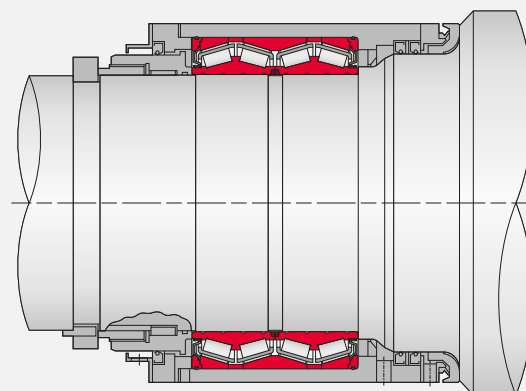
| $F_a / F_r \leq e$ |       | $F_a / F_r > e$ |       |
|--------------------|-------|-----------------|-------|
| X                  | Y     | X               | Y     |
| 1                  | $Y_3$ | 0.67            | $Y_2$ |

Dynamic Equivalent Load:  $P = XF_r + YF_a$

Static Equivalent Load:  $P_0 = F_r + Y_0 F_a$

Where:  $Y_0 = Y_3$

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



| BASIC BEARING NO. | BEARING DIMENSIONS |         |                |                |       |                    | BASIC LOAD RATINGS |        | CONSTANT | AXIAL LOAD FACTORS |                |
|-------------------|--------------------|---------|----------------|----------------|-------|--------------------|--------------------|--------|----------|--------------------|----------------|
|                   | mm                 |         |                |                |       |                    | kN                 |        |          | Y <sub>2</sub>     | Y <sub>3</sub> |
|                   | d                  | D       | B <sub>4</sub> | C <sub>4</sub> | r min | r <sub>1</sub> min | Dynamic            | Static |          |                    |                |
| 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

| Special Material      |     | Bearing Type           |    | Tolerance Type      |   | Spiral Bore Groove |   | Surface Treatment  |       | Grease |
|-----------------------|-----|------------------------|----|---------------------|---|--------------------|---|--------------------|-------|--------|
| STF                   | 343 | KVS                    | 45 | 5                   | 7 | E                  | g | S3                 | CG150 | RN1    |
| Bore Reference Number |     | Bearing O.D. Reference |    | NSK Sequence Number |   | Carburization      |   | Internal Clearance |       |        |

| 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.





## **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.  
Sao Paulo SP  
55.11.3269.4700

### **Argentina**

NSK Argentina SRL  
Buenos Aires  
54.11.4762.6556

### **Latin America**

NSK Latin America Inc.  
Miami FL  
1.305.477.0605

### **Website:**

[www.nskmetals.com](http://www.nskmetals.com)

### **NSK Americas:**

[www.nskamericas.com](http://www.nskamericas.com)

### **NSK Global:**

[www.nsk.com](http://www.nsk.com)

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