



Cylindrical roller bearings

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Designs and variants

SKF manufactures super-precision single row and double row cylindrical roller bearings in three different designs and series. The bearings, which can accommodate axial displacement of the shaft relative to the housing in both directions, are separable, i.e. the bearing ring with the roller and cage assembly can be separated from the other ring. This simplifies mounting and dismounting, particularly when load conditions require both rings to have an interference fit.

SKF super-precision cylindrical roller bearings are characterized by:

- high speed capability
- high radial load carrying capacity
- high rigidity
- low friction
- low cross-sectional height

These bearings are therefore particularly well suited for machine tool spindles where the bearing arrangement must accommodate heavy radial loads and high speeds, while providing a high degree of stiffness.

SKF super-precision single row cylindrical roller bearings have a higher speed capability than double row bearings while double row bearings are more suitable for heavier loads.

Single row cylindrical roller bearings

SKF super-precision single row cylindrical roller bearings in the N 10 series (→ **fig. 1**) have, as standard, a 1:12 tapered bore (designation suffix K). A tapered bore is preferred because the taper enables accurate adjustment of clearance or preload during mounting. The bearings have two integral flanges on the inner ring and no flanges on the outer ring. To improve lubricant flow, these bearings can be supplied with a lubrication hole in the outer ring on request.

Basic design bearings

Basic design single row cylindrical roller bearings are equipped as standard with a roller centred PA66 cage without glass fibre reinforcement for bore diameters up to 80 mm (designation suffix TN), and with glass fibre reinforcement for larger sizes (designation suffix TN9). These bearings are well suited for most precision applications.

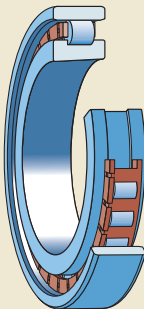
High-speed design bearings

The internal geometry and cages of high-speed design single row cylindrical roller bearings have been optimized to accommodate higher speeds. High-speed design bearings contain fewer rollers than basic design bearings. They are equipped with either an asymmetrical cage, made of glass fibre reinforced PEEK (designation suffix TNHA), or a symmetrical cage, made of carbon fibre reinforced PEEK (designation suffix PHA). Both are outer ring centred cages, designed to optimize the effectiveness of the lubricant and avoid kinematic lubricant starvation at high speeds. When comparing the two cages, the symmetrical PHA cage provides better guidance and promotes better lubrication conditions for superior performance.

Compared to bearings with a glass fibre reinforced PEEK cage, bearings with a carbon fibre reinforced PEEK cage can accommodate speeds up to 30% higher in grease lubricated applications and up to 15% higher when lubricated with an oil-air system.

For applications like the non-tool end of a motorized spindle, where the requirement for higher speed outweighs that for higher rigidity, bearings containing cages with half the number of rollers can be supplied on request.

Fig. 1



Double row cylindrical roller bearings

SKF super-precision double row cylindrical roller bearings (→ **fig. 2**) are manufactured as standard in the NN 30 and NNU 49 series.

Both series are available with either a cylindrical or a 1:12 tapered bore (designation suffix K). In machine tool applications, cylindrical roller bearings with a tapered bore are preferred over bearings with a cylindrical bore, because the taper enables more accurate adjustment of clearance or preload during mounting.

NN 30 series

Bearings in the NN 30 series can provide a unique balance between load carrying capacity, rigidity and speed. They are therefore typically used as the non-tool end bearing in machine tool spindles.

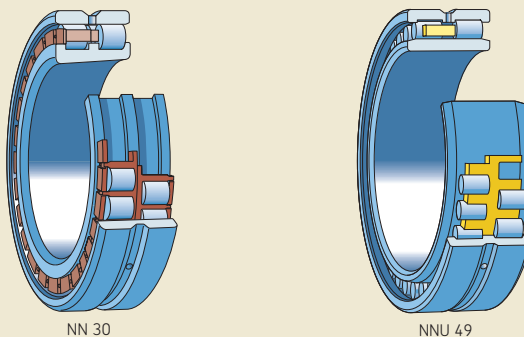
NN 30 series bearings have three integral flanges on the inner ring and no flanges on the outer ring.

NNU 49 series

Bearings in the NNU 49 series, with a very low cross-sectional height, provide a higher degree of stiffness than bearings in the NN 30 series, but a somewhat lower load carrying capacity.

NNU 49 series bearings have three integral flanges on the outer ring and no flanges on the inner ring.

Fig. 2



Annular groove and lubrication holes

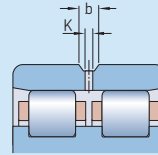
To facilitate efficient lubrication, all bearings in the NNU 49 series and bearings in the NN 30 series with a bore diameter $d \geq 140$ mm, have an annular groove and three lubrication holes in the outer ring (→ **fig. 3**, designation suffix W33).

Bearings without an annular groove and lubrication holes are typically lubricated either with the requisite minimum quantity of grease or with accurately metered, small quantities of oil or oil-air. In this case, the lubricant is delivered through a nozzle, positioned to the side of the bearing (→ **fig. 4** and **product tables**, **page 294**).

If NN 30 series bearings with a bore diameter $d \leq 130$ mm (→ **table 1**) require an annular groove and lubrication holes, check SKF for availability early in the design phase.

Table 1

Annular groove and lubrication hole dimensions for NN 30 .. W33 series bearings ($d \leq 130$ mm)



Bore diameter d	Dimensions b K	
mm	mm	
50	3,7	2
55	3,7	2
60	3,7	2
65	3,7	2
70	5,5	3
75	5,5	3
80	5,5	3
85	5,5	3
90	5,5	3
95	5,5	3
100	5,5	3
105	5,5	3
110	5,5	3
120	5,5	3
130	8,3	4,5

Fig. 3

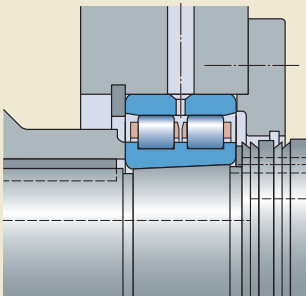
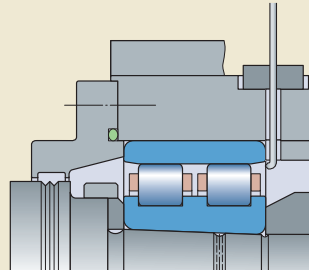


Fig. 4



Bearings with a pre-ground raceway

When there is a demand for an exceptionally high degree of running accuracy, SKF recommends mounting the flangeless inner ring of an NNU 49 series bearing onto the shaft and then finish-grinding the inner ring raceway and other shaft diameters in one operation.

For these applications, SKF can supply NNU 49 series bearings with a tapered bore and a finish-grinding allowance on the inner ring raceway (designation suffix VU001). The finish-grinding allowance, which depends on the bore diameter of the inner ring, is listed in **table 2**.

Cages

SKF super-precision single row cylindrical roller bearings can be fitted with one of the following cages:

- a PA66 cage, window-type, roller centred, designation suffix TN
- a glass fibre reinforced PA66 cage, window-type, roller centred, designation suffix TN9
- a glass fibre reinforced PEEK cage, window-type, outer ring centred, designation suffix TNHA
- a carbon fibre reinforced PEEK cage, window-type, outer ring centred, designation suffix PHA

Depending on their design, series and size, SKF super-precision double row cylindrical roller bearings are fitted as standard with the following cages:

- two PA66 cages, window-type, roller centred, designation suffix TN
- two glass fibre reinforced PA66 cages, window-type, roller centred, designation suffix TN9
- one or two machined brass cages, prong-type, roller centred, no designation suffix

For information about the suitability of cages, refer to *Cage materials* (→ **page 55**).

Table 2

Finish-grinding allowance on the inner ring raceway of NNU 49.. K/VU001 bearings		
Bore diameter		Grinding allowance
d over	incl.	
mm		mm
–	110	0,2
110	360	0,3
360	–	0,4

Hybrid bearings

Hybrid cylindrical roller bearings (designation suffix HC5) are available in the N 10 series and can be supplied on request in the NN 30 series. They have rings made of bearing steel and rollers made of bearing grade silicon nitride (ceramic). As ceramic rollers are lighter and have a higher modulus of elasticity and lower coefficient of thermal expansion than steel rollers, hybrid bearings can provide the following advantages:

- higher degree of rigidity
- higher speed capability
- reduced centrifugal and inertial forces within the bearing
- minimized stress at the outer ring rolling contacts at high speeds
- reduced frictional heat
- less energy consumption
- extended bearing and grease service life
- less prone to skid smearing damage and cage damage when subjected to frequent rapid starts and stops
- less sensitive to temperature differences within the bearing
- more accurate preload control

For additional information about silicon nitride, refer to *Materials for bearing rings and rolling elements* (→ **page 51**).

In order to maximize the performance of a hybrid bearing, SKF recommends using hybrid single row bearings with an outer ring centred window-type PEEK cage (designation suffix PHA or TNHA). These bearings, depending on the cage design, can attain speeds up to $A = 2\,200\,000\text{ mm/min}$, when under light load and lubricated with an oil-air system, (→ **diagram 5, page 40**). They can attain speeds up to $A = 1\,800\,000\text{ mm/min}$, when grease lubricated (→ **diagram 6, page 42**). As an option to further improve lubricant flow, bearings in the N 10 series with a lubrication hole in the outer ring can be supplied on request.

Bearing data

Boundary dimensions	ISO 15
Tolerances For additional information (→ page 47)	• SP class tolerances (→ table 3, page 270) as standard • higher precision UP class tolerances (→ table 4, page 271) on request • SP and UP class tolerances for 1:12 tapered bore (→ table 5, page 272)
Axial displacement	Accommodate axial displacement of the shaft relative to the housing within certain limits (→ product tables). During operation, axial displacement occurs within the bearing and not between the bearing and shaft or housing bore. As a result, there is virtually no increase in friction.

Table 3

SP class tolerances

Inner ring d over incl.		$\Delta_{ds}, \Delta_{dmp}^{1) 2)}$ high low		V_{dp} max.	Δ_{Bs} high low		V_{Bs} max.	K_{ia} max.	S_d max.
mm		μm		μm	μm		μm	μm	μm
–	18	0	–5	3	0	–100	5	3	8
18	30	0	–6	3	0	–100	5	3	8
30	50	0	–8	4	0	–120	5	4	8
50	80	0	–9	5	0	–150	6	4	8
80	120	0	–10	5	0	–200	7	5	9
120	180	0	–13	7	0	–250	8	6	10
180	250	0	–15	8	0	–300	10	8	11
250	315	0	–18	9	0	–350	13	10	13
315	400	0	–23	12	0	–400	15	12	15
400	500	0	–28	14	0	–450	25	12	18
500	630	0	–35	18	0	–500	30	15	20
630	800	0	–45	23	0	–750	35	15	23
Outer ring D over incl.		$\Delta_{Ds}, \Delta_{Dmp}^{2)}$ high low		V_{Dp} max.	Δ_{Cs}, V_{Cs}			K_{ea} max.	S_D max.
mm		μm		μm				μm	μm
30	50	0	–7	4	Values are identical to those for the inner ring of the same bearing.			5	8
50	80	0	–9	5				5	8
80	120	0	–10	5				6	9
120	150	0	–11	6				7	10
150	180	0	–13	7				8	10
180	250	0	–15	8				10	11
250	315	0	–18	9				11	13
315	400	0	–20	10				13	13
400	500	0	–23	12				15	15
500	630	0	–28	14				17	18
630	800	0	–35	18				20	20
800	1 000	0	–50	25				25	30

Tolerance symbols and definitions → table 4, page 48

¹⁾ SP tolerances for 1:12 tapered bore → table 5, page 272

²⁾ Tolerances Δ_{ds} and Δ_{Ds} apply to NNU design bearings with an outside diameter $D \leq 630$ mm. Tolerances Δ_{dmp} and Δ_{Dmp} apply to larger NNU design bearings and to N and NN design bearings.

Table 4

UP class tolerances

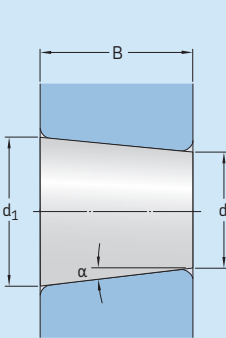
Inner ring d		$\Delta_{ds}^{1)}$		V_{dp} max.	Δ_{Bs}		V_{Bs} max.	K_{ia} max.	S_d max.
over	incl.	high	low		high	low			
mm		μm		μm	μm		μm	μm	
–	18	0	–4	2	0	–70	1,5	1,5	2
18	30	0	–5	2,5	0	–80	1,5	1,5	3
30	50	0	–6	3	0	–100	2	2	3
50	80	0	–7	3,5	0	–100	3	2	4
80	120	0	–8	4	0	–100	3	3	4
120	180	0	–10	5	0	–100	4	3	5
180	250	0	–12	6	0	–150	5	4	6
250	315	0	–15	8	0	–150	5	4	6
315	400	0	–19	10	0	–150	6	5	7
400	500	0	–23	12	0	–200	7	5	8
500	630	0	–26	13	0	–200	8	6	9
630	800	0	–34	17	0	–200	10	7	11
Outer ring D		Δ_{Ds}		V_{Dp} max.	Δ_{Cs}, V_{Cs}		K_{ea} max.	S_D max.	
over	incl.	high	low						
mm		μm		μm			μm	μm	
30	50	0	–5	3	Values are identical to those for the inner ring of the same bearing.		3	2	
50	80	0	–6	3			3	2	
80	120	0	–7	4			3	3	
120	150	0	–8	4			4	3	
150	180	0	–9	5			4	3	
180	250	0	–10	5			5	4	
250	315	0	–12	6			6	4	
315	400	0	–14	7			7	5	
400	500	0	–17	9			8	5	
500	630	0	–20	10			9	6	
630	800	0	–25	13			11	7	
800	1 000	0	–30	15			12	10	

Tolerance symbols and definitions → table 4, page 48

¹⁾ UP tolerances for 1:12 tapered bore → table 5, page 272

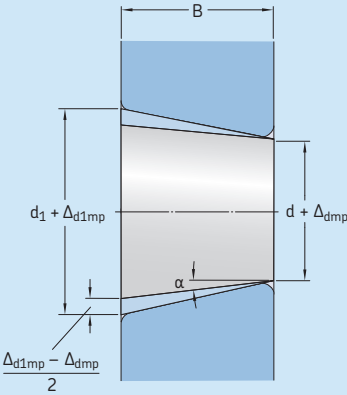
Table 5

SP and UP class tolerances for 1:12 tapered bore



Half angle of taper 1:12

$$\alpha = 2^\circ 23' 9,4''$$



Largest theoretical diameter d_1

$$d_1 = d + \frac{1}{12} B$$

Bore diameter		SP class tolerances			UP class tolerances					
d	incl.	Δ_{dmp}		$V_{dp}^{(1)}$	Δ_{d1mp}	$-\Delta_{dmp}$	Δ_{dmp}	$V_{dp}^{(1)}$	Δ_{d1mp}	$-\Delta_{dmp}$
mm		μm		μm	μm	low	μm	μm	μm	low
18	30	+10	0	3	+4	0	+6	0	2,5	0
30	50	+12	0	4	+4	0	+7	0	3	0
50	80	+15	0	5	+5	0	+8	0	3,5	0
80	120	+20	0	5	+6	0	+10	0	4	0
120	180	+25	0	7	+8	0	+12	0	5	0
180	250	+30	0	8	+10	0	+14	0	6	0
250	315	+35	0	9	+12	0	+15	0	8	0
315	400	+40	0	12	+12	0	+17	0	10	0
400	500	+45	0	14	+14	0	+19	0	12	0
500	630	+50	0	18	+15	0	+20	0	13	0
630	800	+65	0	23	+19	0	+22	0	17	0

Tolerance symbols and definitions → table 4, page 48

¹⁾ Applies to any single radial plane of the bore.

Radial internal clearance

SKF super-precision cylindrical roller bearings manufactured to the SP tolerance class are supplied with C1 radial internal clearance (no designation suffix) as standard.

On request, bearings in the N 10 and NN 30 series can also be supplied with a special reduced radial clearance (smaller than C1), when a minimum operating clearance or a preload after mounting is required. For information about clearance values and availability, contact the SKF application engineering service.

Bearings made to the SP tolerance class, particularly those in the NNU 49 series, are also available with a radial internal clearance greater than C1. When ordering, the requisite clearance should be indicated in the designation by the suffix:

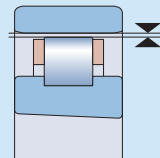
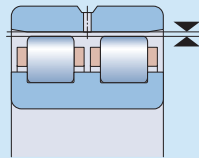
- SPC2 for clearance greater than C1
- CN for Normal clearance, greater than SPC2
- C3 for clearance greater than Normal

The values for radial internal clearance are listed in **table 6 (→ page 274)**. They are in accordance with ISO 5753-1 (except for SPC2) and are valid for new, unmounted bearings under zero measuring load. SPC2 radial clearance values deviate from those standardized for C2. The clearance range is reduced and displaced toward the lower limit.

To achieve the required radial internal clearance, the rings of individual bearings are matched at the factory, marked with the same identification number and usually packaged together in a single box. Be sure to check that the numbers on both rings match prior to mounting. Any mismatch could have a negative impact on the radial internal clearance and the performance characteristics of the final assembly.

Table 6

Radial internal clearance of super-precision cylindrical roller bearings



Bore diameter		Radial internal clearance								Bearings with a tapered bore			
d	incl.	Bearings with a cylindrical bore								C1			
over		min.	max.	SPC2	max.	Normal	max.	C3	max.	min.	max.	SPC2	max.
mm		μm								μm			
24	30	5	15	10	25	20	45	35	60	15	25	25	35
30	40	5	15	12	25	25	50	45	70	15	25	25	40
40	50	5	18	15	30	30	60	50	80	17	30	30	45
50	65	5	20	15	35	40	70	60	90	20	35	35	50
65	80	10	25	20	40	40	75	65	100	25	40	40	60
80	100	10	30	25	45	50	85	75	110	35	55	45	70
100	120	10	30	25	50	50	90	85	125	40	60	50	80
120	140	10	35	30	60	60	105	100	145	45	70	60	90
140	160	10	35	35	65	70	120	115	165	50	75	65	100
160	180	10	40	35	75	75	125	120	170	55	85	75	110
180	200	15	45	40	80	90	145	140	195	60	90	80	120
200	225	15	50	45	90	105	165	160	220	60	95	90	135
225	250	15	50	50	100	110	175	170	235	65	100	100	150
250	280	20	55	55	110	125	195	190	260	75	110	110	165
280	315	20	60	60	120	130	205	200	275	80	120	120	180
315	355	20	65	65	135	145	225	225	305	90	135	135	200
355	400	25	75	75	150	190	280	280	370	100	150	150	225
400	450	25	85	85	170	210	310	310	410	110	170	170	255
450	500	25	95	95	190	220	330	330	440	120	190	190	285
500	560	25	105	105	210	240	360	360	480	130	210	210	315
560	630	25	115	115	230	260	380	380	500	140	230	230	345
630	710	30	130	130	260	260	380	380	500	160	260	260	390
710	800	35	145	145	290	290	425	425	565	180	290	290	435

Radial internal clearance or preload in mounted bearings

To optimize running accuracy and stiffness, super-precision cylindrical roller bearings should have a minimum radial internal clearance or preload after mounting. Cylindrical roller bearings with a tapered bore are generally mounted with preload.

The required operating clearance or preload depends on the speed, load, lubricant and required stiffness of the complete spindle / bearing system. The geometrical accuracy of the bearing seats also play a key role in being able to obtain the necessary clearance or preload. The operating temperature and temperature distribution within the bearing should also be taken into consideration, since a reduction in operating clearance or an increase in preload may result.

Radial stiffness

Radial stiffness depends on the elastic deformation (deflection) of the bearing under load and can be expressed as a ratio of load to deflection. However, since the relationship between deflection and load is not linear, only guideline values can be provided (→ **table 7, page 276**). These values apply to moderately preloaded, mounted bearings under static conditions, subjected to moderate loads.

More accurate values for radial stiffness can be calculated using advanced computer programs. For additional information, contact the SKF application engineering service and refer to *Bearing stiffness* (→ **page 68**).

Table 7

Static radial stiffness

Bore diameter d	Static radial stiffness N 10						NN 30 ¹⁾ with steel rollers	NNU 49 ¹⁾ with steel rollers
	with steel rollers			with ceramic rollers				
	TN(9) cage	TNHA cage	PHA cage	TN(9) cage	TNHA cage	PHA cage		
mm	N/μm						N/μm	N/μm
25	–	–	–	–	–	–	640	–
30	–	–	–	–	–	–	690	–
35	–	–	–	–	–	–	820	–
40	450	430	390	610	580	510	890	–
45	480	460	410	620	590	530	940	–
50	530	510	460	690	660	590	1 040	–
55	620	590	540	810	770	700	1 220	–
60	680	650	590	890	850	770	1 330	–
65	740	710	650	970	930	840	1 450	–
70	810	780	720	1 090	1 050	950	1 610	–
75	820	790	720	1 090	1 050	960	1 610	–
80	920	880	810	1 190	1 140	1 040	1 820	–
85	990	950	–	1 280	1 230	–	1 970	–
90	980	940	–	1 320	1 270	–	2 010	–
95	1 060	1 020	–	1 430	1 380	–	2 190	–
100	1 140	1 100	–	1 540	1 490	–	2 350	2 950
105	1 140	1 100	–	1 540	1 490	–	2 330	3 040
110	1 210	1 160	–	1 600	1 540	–	2 470	3 130
120	1 310	1 260	–	1 730	1 670	–	2 760	3 140
130	–	–	–	–	–	–	2 900	3 570
140	–	–	–	–	–	–	3 070	3 670
150	–	–	–	–	–	–	3 310	4 160
160	–	–	–	–	–	–	3 540	4 310
170	–	–	–	–	–	–	3 790	4 460
180	–	–	–	–	–	–	3 970	5 190
190	–	–	–	–	–	–	4 280	5 380
200	–	–	–	–	–	–	4 380	5 480
220	–	–	–	–	–	–	4 700	5 990
240	–	–	–	–	–	–	5 180	6 340
260	–	–	–	–	–	–	5 570	6 830
280	–	–	–	–	–	–	6 010	7 260

¹⁾ For bearings in the NN 30 and NNU 49 series with d > 280 mm, contact the SKF application engineering service.

Equivalent bearing loads

The equivalent dynamic bearing load can be calculated using

$$P = F_r$$

The equivalent static bearing load can be calculated using

$$P_0 = F_r$$

where

P = equivalent dynamic bearing load [kN]

P_0 = equivalent static bearing load [kN]

F_r = radial load [kN]

Attainable speeds

The attainable speeds listed in the product tables are guideline values based on cylindrical roller bearings with a near zero radial internal clearance (→ *Attainable speeds*, **page 44**).

In applications where operating radial internal clearance > 0,002 mm or preload is applied or where seats and abutments do not meet accuracy requirements, the speed ratings must be reduced (→ *Recommended shaft and housing fits* and *Accuracy of seats and abutments*, **pages 70 and 75**).

The attainable speeds for preloaded bearings in the N 10 and NN 30 series can be estimated using the guideline values listed in **table 8**. For attainable speeds of preloaded bearings in the NNU 49 series, contact the SKF application engineering service.

Table 8

Attainable speed factor for preloaded bearings in the N 10 and NN 30 series

Preload		Speed factor
min.	max.	$A = n \cdot d_m$
μm		mm/min
0	2	$\leq 1\,300\,000$
1	3	$\leq 1\,000\,000$
2	5	$\leq 500\,000$

n = rotational speed [r/min]
 d_m = bearing mean diameter [mm]
 $= 0,5 (d + D)$

Design considerations

Adjusting for clearance or preload

When mounting a cylindrical roller bearing with a tapered bore, radial internal clearance or preload is determined by how far the bearing inner ring is driven up on its tapered seat. The further up the seat the ring is driven, the more it expands and the less radial internal clearance there will be, until eventually, there is a radial preload in the bearing. To quickly and accurately obtain the specified clearance or preload when mounting a bearing, SKF recommends using gauges (→ **page 391**). Gauges are particularly useful when mounting two or three bearings as it is not necessary to measure and calculate the axial drive-up distance for each bearing (→ *Mounting*, **page 280**).

If obtaining an exact radial internal clearance or preload is not critical or SKF gauges are not available, it is possible to determine the required axial drive-up distance. To do this, locate the assembled bearing at a reference point on the shaft and measure the radial internal clearance with a dial indicator positioned on the outside surface of the outer ring (→ *Mounting bearings with a tapered bore by measuring radial clearance prior to mounting*, **page 284**).

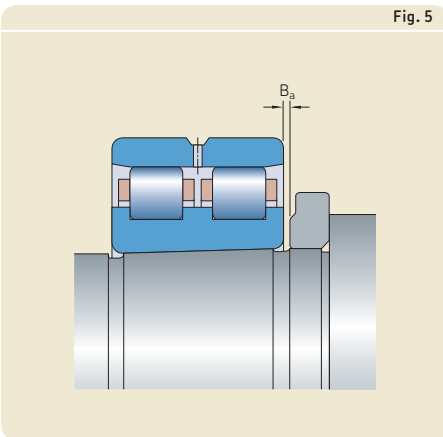


Fig. 5

With the radial internal clearance measured using either of the above methods, the axial drive-up distance can be obtained using

$$B_a = \frac{e \ c}{1\ 000}$$

If the bearing is to be mounted against a distance ring (→ **fig. 5**), the width of the distance ring must be adjusted to obtain the value B_a .

If there is no fixed abutment and a threaded nut is used to drive the inner ring assembly up on its tapered seat, the angle through which the nut should be turned can be calculated using

$$\alpha = \frac{360 \ e \ c}{1\ 000 \ p}$$

where

B_a = axial drive-up [mm]

α = requisite nut tightening angle [°]

c = measured radial internal clearance at the reference point

- plus the required preload [μm] for preload
- minus the required clearance [μm] for clearance
- minus the adjustment [μm] for an interference fit in the housing bore when not using SKF gauges (→ *Mounting bearings with a tapered bore by measuring radial clearance prior to mounting*)

e = a factor depending on the diameter ratio of the hollow shaft and the bearing series (→ **fig. 6** and **table 9**)

p = thread lead of the nut [mm]

For mounting procedures for super-precision cylindrical roller bearings, refer to *Mounting* (→ **page 280**).

Calculation example

Determine the axial drive-up for a double row cylindrical roller bearing mounted on a hollow shaft. Input data:

- bearing NN 3040 K/SPW33
- measured residual radial internal clearance = 10 μm
- requisite preload = 2 μm
- mean bearing seat diameter d_{om} = 203 mm
- internal diameter of the hollow shaft d_i = 140 mm

From **table 9** $e = 18$ for $d_i/d_{om} = 140/203 = 0,69$
With $c = 10 + 2 = 12 \mu\text{m}$

$$B_a = \frac{18 \times 12}{1\,000} = 0,216 \text{ mm}$$

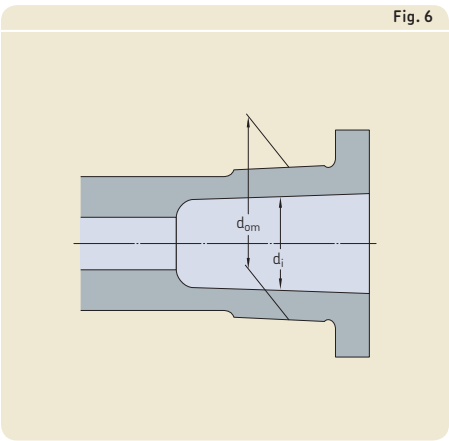


Table 9

Factor e

Hollow shaft
diameter ratio
 d_i/d_{om}
over incl.

Factor e for bearings in the series

N 10 K, NN 30 K NNU 49 K

–	0,2	12,5	12
0,2	0,3	14,5	13
0,3	0,4	15	14
0,4	0,5	16	15
0,5	0,6	17	18
0,6	0,7	18	17

Free space on both sides of the bearing

To be sure that N 10 and NN 30 series bearings, with a polymer cage (designation suffix TN, TN9, TNHA or PHA), can accommodate axial displacement of the shaft relative to the housing, free space must be provided on both sides of the bearing (→ **fig. 7**). This prevents damage that might otherwise occur if the cage makes contact with an adjacent component. The minimum width of this free space should be

$$C_a = 1,3 s$$

where

C_a = minimum width of free space [mm]

s = permissible axial displacement from the normal position of one bearing ring relative to the other [mm] (→ **product tables**)

Mounting

To achieve the required radial internal clearance, the rings of individual bearings are matched at the factory, marked with the same identification number and usually packaged together in a single box. Be sure to check that the numbers on both rings match prior to mounting. Any mismatch could have a negative impact on the radial internal clearance and the performance characteristics of the final assembly.

When mounting super-precision cylindrical roller bearings with a tapered bore, the radial internal clearance or preload must be adjusted accurately. This is done by driving the inner ring up on its tapered shaft seat (→ **fig. 8**). The resulting expansion of the inner ring determines the internal clearance or preload in the mounted bearing. For proper mounting, the inside or outside envelope diameter of the roller set must be accurately measured. SKF internal clearance gauges in the GB 30 and GB 10 (→ **fig. 9**) or GB 49 (→ **fig. 10**) series enable simple and accurate measurements. For additional information about internal clearance gauges, refer to *Gauges* (→ **page 391**).

Mounting a cylindrical roller bearing in the NN 30 K series using a GB 30 series gauge is described in the following. The same procedure can be applied when mounting cylindrical roller bearings in the N 10 K series using either a GB 10 or GB 30 series gauge. A similar procedure can be applied when mounting cylin-

Fig. 7

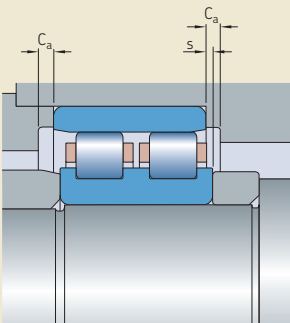


Fig. 8

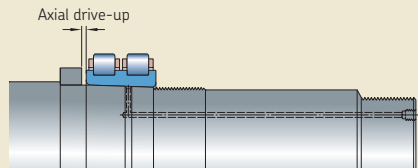


Fig. 9



GB 3006 ... GB 3020
GB 1010 ... GB 1020



GB 3021 ... GB 3068

3

Fig. 10



GB 4920 ... GB 4938



GB 4940 ... GB 4960

dricl roller bearings in the NNU 49 K series using a GB 49 series gauge.

When mounting without the assistance of an internal clearance gauge, be sure that the accuracy of the readings is sufficient for the application requirements.

Mounting a bearing in the NN 30 K series using a GB 30 series gauge

To mount a bearing in the NN 30 K series, SKF recommends using a GB 30 gauge (→ **page 400**), a bore gauge and the appropriate hydraulic tools to drive the bearing up onto its seat. Provisions for oil injection are useful for dismounting (→ *Provisions for mounting and dismounting*, **page 88**). The typical mounting procedure comprises the following steps:

- 1 Mounting the outer ring
 - Heat the housing to the appropriate temperature and slide the outer ring in position.
- 2 Preparing the gauge
 - Let the housing and the outer ring cool to ambient temperature. Set a bore gauge to the raceway diameter and zero the indicator (→ **fig. 11**).
 - Place the gauge in the centre of the gauging zone of the GB 30 gauge (→ **fig. 12**). Adjust the GB 30 gauge, using the adjustment screw until the bore gauge indicates zero minus the correction value listed in the GB 30 user instructions.
 - Increase the inside diameter of the GB 30 gauge by the value of the desired preload or reduce the inside diameter by the value of the desired clearance, using the adjustment screw. Then set the GB 30 gauge indicator to zero. Keep this indicator setting unchanged during the mounting process.
- 3 Mounting the inner ring (trial)
 - Coat the tapered shaft seat with a thin layer of light oil and push the inner ring, roller and cage assembly until the bearing bore makes good contact with its seat.
 - Expand the GB 30 gauge with the adjustment screw, place it over the roller set and release the adjustment screw so that the gauge makes contact with the roller set (→ **fig. 13**).
- Drive the inner ring roller and cage assembly together with the gauge further up on its seat until the indicator on the gauge reads zero. The inner ring is now in the correct position for the desired preload or clearance.
 - Expand the gauge using the adjustment screw and remove it from the roller and cage assembly.
- 4 Mounting the inner ring (final)
 - Measure the distance between the bearing side face and the shaft abutment using gauge blocks (→ **fig. 14**). Take measurements at different diametrical positions to check accuracy and misalignment. The difference between the single measurements should not exceed 3 to 4 µm.
 - Grind a pre-machined spacer ring to the measured width.
 - Remove the inner ring, mount the spacer ring, and drive up the inner ring again, until it firmly abuts the spacer ring.
 - Place the GB 30 gauge over the roller set as described earlier. Release the adjustment screw. If the indicator reads zero again, the inner ring is properly mounted. Remove the gauge and locate the inner ring, using a suitable locking device.

Fig. 11



Fig. 12



Fig. 13



Fig. 14



Mounting bearings with a tapered bore by measuring radial clearance prior to mounting

If obtaining an exact radial internal clearance or preload is not critical or if SKF gauges are not available, it is possible to determine the required axial drive-up distance. To do this, locate the assembled bearing at a reference point on the shaft and measure the radial internal clearance with a dial indicator positioned on the outside surface of the outer ring. This method does not take into account that the outer ring is compressed when mounted with an interference fit in the housing. To compensate for this, it can be assumed that the outer ring raceway diameter will decrease by 80% of the diametric interference fit. The procedure comprises the following steps:

- 1 Mounting the inner ring (trial)
 - Coat the tapered shaft seat with a thin layer of light oil and push the assembled bearing in place until the bearing bore makes good contact with its seat.
 - There should still be clearance between the outer ring and rollers.
 - Keep in mind that small bearings may have only 15 µm internal clearance prior to mounting and that an axial drive-up of 0,1 mm causes a clearance reduction of ~ 8 µm.

- 2 Measuring the internal clearance prior to mounting
 - Place a spacer ring onto the shaft and position it between the bearing inner ring side face and drive-up device. The spacer, which must be parallel to the bearing inner ring side face, is there to guide the outer ring side face when measuring radial clearance (→ fig. 15).
 - To measure the radial clearance, place a dial indicator on the outer ring circumference and set the indicator to zero.
 - Holding the outer ring firmly against the spacer, move the outer ring up or down, and measure the total displacement. This measured distance is the radial clearance in the bearing, prior to mounting.
 - Do not apply excessive force to the outer ring. Elastic deformation may cause measurement errors.
- 3 Determine the required axial drive-up distance B_a (→ *Adjusting for clearance or preload*, page 278) remembering to include the allowance for outer ring interference fit, if one exists.
- 4 Determining the spacer ring width
 - Measure the distance L between the bearing side face and the shaft abutment (→ fig. 15). Take measurements at different diametrical positions to check accuracy and misalignment. The difference between the single measurements should not exceed 3 to 4 µm.
 - Calculate the required width of the spacer ring using

$$B = L - B_a$$

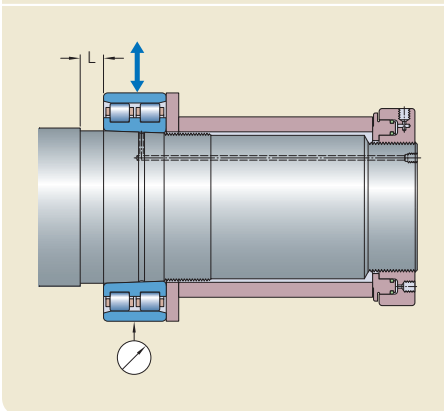
where

B = required width of the spacer ring

L = mean measured distance from the bearing inner ring to the abutment

B_a = the required axial drive-up distance to achieve the desired clearance reduction or preload (→ *Adjusting for clearance or preload*, page 278)

Fig. 15



5 Mounting the bearing (final)

- Grind the pre-machined spacer ring to the required width.
- Remove the assembled bearing, mount the spacer ring, and drive up the inner ring roller and cage assembly again until it firmly abuts the spacer ring.
- Locate the inner ring using a suitable locking device.
- Heat the housing to the required temperature and mount the outer ring.

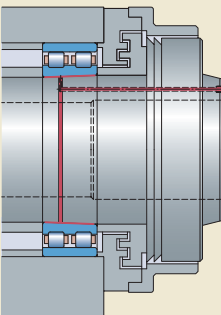
Mounting and dismounting, using the oil injection method

Particularly where large bearings are involved, it is often necessary to make provisions during the design stage, to facilitate mounting and dismounting of a bearing, or even to make it possible at all.

For super-precision cylindrical roller bearings with a bore diameter $d > 80$ mm, SKF recommends the oil injection method. With the oil injection method, oil under high pressure is injected via ducts and distribution grooves between the bearing and bearing seat to form an oil film (→ **fig. 16**). This oil film separates the mating surfaces and considerably reduces the friction between them and virtually eliminates the risk of damaging the bearing or the spindle shaft. This method is typically used when mounting or dismounting bearings directly on tapered shaft seats. Where bearings with a cylindrical bore are concerned, the oil injection method can only be used for dismounting.

To apply the oil injection method, the spindle must contain ducts and grooves (→ *Provisions for mounting and dismounting*, **page 88**).

Fig. 16



Designation system

Examples: N 1016 KPHA/HC5SP
NN 3020 KTN9/SPVR521
NNU 49/500 B/SPC3W33X

N	10	16	K	PHA	/	HC5	SP	
NN	30	20	K	TN9	/		SP	VR521
NNU	49	/500	B		/		SPC3	W33X

Bearing design

N Single row cylindrical roller bearing
NN Double row cylindrical roller bearing
NNU Double row cylindrical roller bearing

Dimension series

10 In accordance with ISO dimension series 10
30 In accordance with ISO dimension series 30
49 In accordance with ISO dimension series 49

Bearing size

05 (x5) 25 mm bore diameter
to
92 (x5) 460 mm bore diameter
from
/500 Bore diameter uncoded [mm]

Internal design and bore shape

– Cylindrical bore (no designation suffix)
B Modified internal design
K Tapered bore, taper 1:12

Cage

– Machined brass cage, roller centred (no designation suffix)
PHA Carbon fibre reinforced PEEK cage, outer ring centred
TN PA66 cage, roller centred
TN9 Glass fibre reinforced PA66 cage, roller centred
TNHA Glass fibre reinforced PEEK cage, outer ring centred

Roller material

– Carbon chromium steel (no designation suffix)
HC5 Rollers made of bearing grade silicon nitride Si_3N_4 (hybrid bearing)

Tolerance class and internal clearance

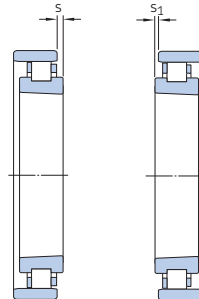
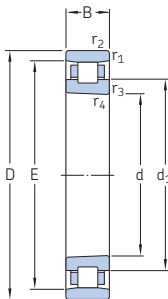
SP Dimensional accuracy in accordance with ISO tolerance class 5, running accuracy in accordance with ISO tolerance class 4
UP Dimensional accuracy in accordance with ISO tolerance class 4, running accuracy better than ISO tolerance class 4
– Standard radial internal clearance C1 (no designation suffix)
C2 Radial internal clearance greater than C1
CN Normal radial internal clearance
C3 Radial internal clearance greater than Normal

Other variants

VR521 Bearing supplied with measuring report (standard for NN 30 series bearings with $d > 130$ mm)
VU001 Inner ring raceway with finish-grinding allowance
W33 Annular groove and three lubrication holes in the outer ring
W33X Annular groove and six lubrication holes in the outer ring

3.1 Single row cylindrical roller bearings

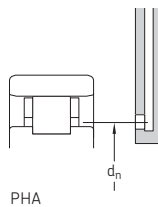
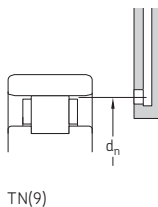
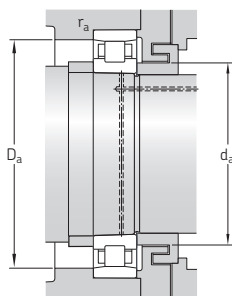
d 40 – 60 mm



TN(9), PHA

TNHA

Principal dimensions			Basic load ratings		Fatigue load limit	Attainable speeds		Mass	Designation
d	D	B	dynamic C	static C ₀	P _u	Grease lubrica- tion	Oil-air lubrication	kg	Bearing with a tapered bore
mm			kN		kN	r/min			–
40	68	15	23,3	25	2,9	30 000	36 000	0,19	N 1008 KPHA/SP
	68	15	23,3	25	2,9	32 000	38 000	0,17	N 1008 KPHA/HC5SP
	68	15	24,2	26,5	3,05	22 000	32 000	0,19	N 1008 KTNHA/SP
	68	15	24,2	26,5	3,05	26 000	36 000	0,17	N 1008 KTNHA/HC5SP
	68	15	25,1	28	3,2	15 000	17 000	0,19	N 1008 KTN/SP
	68	15	25,1	28	3,2	18 000	20 000	0,17	N 1008 KTN/HC5SP
45	75	16	27	30	3,45	28 000	34 000	0,24	N 1009 KPHA/SP
	75	16	27	30	3,45	30 000	36 000	0,2	N 1009 KPHA/HC5SP
	75	16	28,1	31	3,65	20 000	28 000	0,24	N 1009 KTNHA/SP
	75	16	28,1	31	3,65	22 000	32 000	0,21	N 1009 KTNHA/HC5SP
	75	16	29,2	32,5	3,8	14 000	15 000	0,24	N 1009 KTN/SP
	75	16	29,2	32,5	3,8	16 000	18 000	0,22	N 1009 KTN/HC5SP
50	80	16	28,6	33,5	3,8	26 000	30 000	0,26	N 1010 KPHA/SP
	80	16	28,6	33,5	3,8	28 000	32 000	0,22	N 1010 KPHA/HC5SP
	80	16	29,7	34,5	4,05	19 000	26 000	0,26	N 1010 KTNHA/SP
	80	16	29,7	34,5	4,05	20 000	28 000	0,23	N 1010 KTNHA/HC5SP
	80	16	30,8	36,5	4,25	13 000	14 000	0,26	N 1010 KTN/SP
	80	16	30,8	36,5	4,25	15 000	17 000	0,23	N 1010 KTN/HC5SP
55	90	18	37,4	44	5,2	22 000	28 000	0,38	N 1011 KPHA/SP
	90	18	37,4	44	5,2	24 000	30 000	0,32	N 1011 KPHA/HC5SP
	90	18	39,1	46,5	5,5	17 000	24 000	0,39	N 1011 KTNHA/SP
	90	18	39,1	46,5	5,5	19 000	26 000	0,35	N 1011 KTNHA/HC5SP
	90	18	40,2	48	5,7	12 000	13 000	0,39	N 1011 KTN/SP
	90	18	40,2	48	5,7	13 000	15 000	0,35	N 1011 KTN/HC5SP
60	95	18	40,2	49	5,85	20 000	26 000	0,4	N 1012 KPHA/SP
	95	18	40,2	49	5,85	22 000	28 000	0,33	N 1012 KPHA/HC5SP
	95	18	41,3	51	6,1	16 000	22 000	0,41	N 1012 KTNHA/SP
	95	18	41,3	51	6,1	18 000	24 000	0,37	N 1012 KTNHA/HC5SP
	95	18	42,9	53	6,3	11 000	12 000	0,41	N 1012 KTN/SP
	95	18	42,9	53	6,3	12 000	14 000	0,37	N 1012 KTN/HC5SP



Dimensions							Abutment and fillet dimensions					Reference grease quantity ¹⁾
d	d ₁	E	r _{1,2} min.	r _{3,4} min.	s ²⁾	s ₁ ²⁾	d _a min.	D _a min.	D _a max.	r _a max.	d _n ³⁾	G _{ref}
mm							mm					cm ³
40	50,6	61	1	0,6	2	–	45	62	63	1	52,1	3,1
	50,6	61	1	0,6	2	–	45	62	63	1	52,1	3,1
	50,6	61	1	0,6	2	1,5	45	62	63	1	–	2,5
	50,6	61	1	0,6	2	1,5	45	62	63	1	–	2,5
	50,6	61	1	0,6	2	–	45	62	63	1	60	2,3
	50,6	61	1	0,6	2	–	45	62	63	1	60	2,3
45	56,3	67,5	1	0,6	2	–	50	69	70	1	57,9	4,1
	56,3	67,5	1	0,6	2	–	50	69	70	1	57,9	4,1
	56,3	67,5	1	0,6	2	1,5	50	69	70	1	–	3,2
	56,3	67,5	1	0,6	2	1,5	50	69	70	1	–	3,2
	56,3	67,5	1	0,6	2	–	50	69	70	1	66,4	2,9
	56,3	67,5	1	0,6	2	–	50	69	70	1	66,4	2,9
50	61,3	72,5	1	0,6	2	–	55	74	75	1	63	4,4
	61,3	72,5	1	0,6	2	–	55	74	75	1	63	4,4
	61,3	72,5	1	0,6	2	1,5	55	74	75	1	–	3,5
	61,3	72,5	1	0,6	2	1,5	55	74	75	1	–	3,5
	61,3	72,5	1	0,6	2	–	55	74	75	1	71,4	3,2
	61,3	72,5	1	0,6	2	–	55	74	75	1	71,4	3,2
55	68,2	81	1,1	0,6	2,5	–	61,5	82	83,5	1	70,1	6,1
	68,2	81	1,1	0,6	2,5	–	61,5	82	83,5	1	70,1	6,1
	68,2	81	1,1	0,6	2,5	1,5	61,5	82	83,5	1	–	4,9
	68,2	81	1,1	0,6	2,5	1,5	61,5	82	83,5	1	–	4,9
	68,2	81	1,1	0,6	2,5	–	61,5	82	83,5	1	79,8	4,4
	68,2	81	1,1	0,6	2,5	–	61,5	82	83,5	1	79,8	4,4
60	73,3	86,1	1,1	0,6	2,5	–	66,5	87	88,5	1	75,2	6,5
	73,3	86,1	1,1	0,6	2,5	–	66,5	87	88,5	1	75,2	6,5
	73,3	86,1	1,1	0,6	2,5	1,5	66,5	87	88,5	1	–	5,2
	73,3	86,1	1,1	0,6	2,5	1,5	66,5	87	88,5	1	–	5,2
	73,3	86,1	1,1	0,6	2,5	–	66,5	87	88,5	1	85	4,7
	73,3	86,1	1,1	0,6	2,5	–	66,5	87	88,5	1	85	4,7

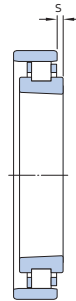
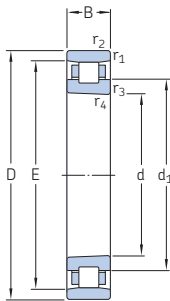
¹⁾ For calculating the initial grease fill → page 101

²⁾ Permissible axial displacement from the normal position of one bearing ring relative to the other.

³⁾ For bearings equipped with a TNHA cage, contact the SKF application engineering service.

3.1 Single row cylindrical roller bearings

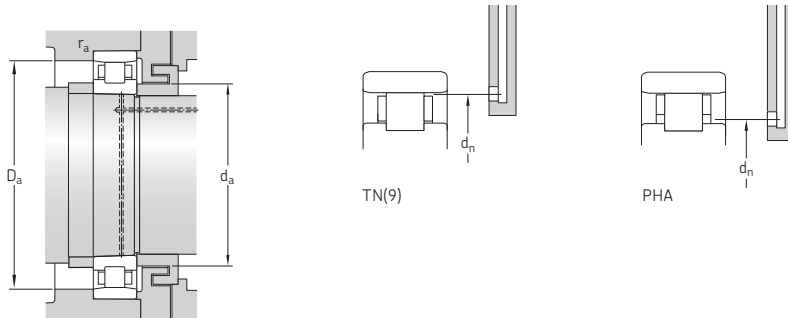
d 65 – 90 mm



TN(9), PHA

TNHA

Principal dimensions			Basic load ratings		Fatigue load limit	Attainable speeds		Mass	Designation
d	D	B	dynamic C	static C ₀	P _u	Grease lubrica- tion	Oil-air lubrication		Bearing with a tapered bore
mm			kN		kN	r/min		kg	–
65	100	18	42,9	54	6,3	20 000	24 000	0,43	N 1013 KPHA/SP
	100	18	42,9	54	6,3	22 000	26 000	0,35	N 1013 KPHA/HC5SP
	100	18	44	56	6,55	15 000	20 000	0,44	N 1013 KTNHA/SP
	100	18	44	56	6,55	17 000	22 000	0,39	N 1013 KTNHA/HC5SP
	100	18	44,6	58,5	6,8	10 000	11 000	0,44	N 1013 KTN/SP
	100	18	44,6	58,5	6,8	11 000	13 000	0,39	N 1013 KTN/HC5SP
70	110	20	53,9	69,5	8	18 000	22 000	0,61	N 1014 KPHA/SP
	110	20	53,9	69,5	8	20 000	24 000	0,5	N 1014 KPHA/HC5SP
	110	20	55	72	8,3	13 000	19 000	0,62	N 1014 KTNHA/SP
	110	20	55	72	8,3	15 000	20 000	0,55	N 1014 KTNHA/HC5SP
	110	20	57,2	75	8,65	9 500	10 000	0,62	N 1014 KTN/SP
	110	20	57,2	75	8,65	10 000	12 000	0,55	N 1014 KTN/HC5SP
75	115	20	52,8	69,5	8,15	17 000	20 000	0,64	N 1015 KPHA/SP
	115	20	52,8	69,5	8,15	19 000	22 000	0,53	N 1015 KPHA/HC5SP
	115	20	55	72	8,5	13 000	18 000	0,65	N 1015 KTNHA/SP
	115	20	55	72	8,5	14 000	20 000	0,57	N 1015 KTNHA/HC5SP
	115	20	56,1	75	8,8	9 000	9 500	0,65	N 1015 KTN/SP
	115	20	56,1	75	8,8	9 500	11 000	0,57	N 1015 KTN/HC5SP
80	125	22	66	86,5	10,2	16 000	19 000	0,88	N 1016 KPHA/SP
	125	22	66	86,5	10,2	18 000	20 000	0,73	N 1016 KPHA/HC5SP
	125	22	67,1	90	10,6	12 000	16 000	0,88	N 1016 KTNHA/SP
	125	22	67,1	90	10,6	13 000	18 000	0,79	N 1016 KTNHA/HC5SP
	125	22	69,3	93	11	8 500	9 000	0,89	N 1016 KTN/SP
	125	22	69,3	93	11	9 000	10 000	0,79	N 1016 KTN/HC5SP
85	130	22	70,4	98	11,2	11 000	16 000	0,89	N 1017 KTNHA/SP
	130	22	70,4	98	11,2	13 000	17 000	0,79	N 1017 KTNHA/HC5SP
	130	22	73,7	102	11,6	8 000	8 500	0,9	N 1017 KTN9/SP
	130	22	73,7	102	11,6	9 000	10 000	0,8	N 1017 KTN9/HC5SP
90	140	24	76,5	104	12,5	10 000	14 000	1,2	N 1018 KTNHA/SP
	140	24	76,5	104	12,5	12 000	16 000	1,05	N 1018 KTNHA/HC5SP
	140	24	79,2	108	12,9	7 000	8 000	1,2	N 1018 KTN9/SP
	140	24	79,2	108	12,9	8 500	9 500	1,1	N 1018 KTN9/HC5SP



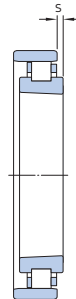
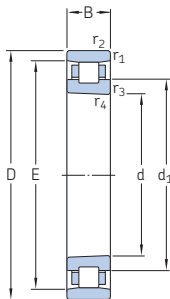
Dimensions							Abutment and fillet dimensions					Reference grease quantity ¹⁾ G _{ref}
d	d ₁	E	r _{1,2} min.	r _{3,4} min.	s ²⁾	s ₁ ²⁾	d _a min.	D _a min.	D _a max.	r _a max.	d _n ³⁾	
mm							mm					cm ³
65	78,2	91	1,1	0,6	2,5	–	71,5	92	93,5	1	80,1	6,9
	78,2	91	1,1	0,6	2,5	–	71,5	92	93,5	1	80,1	6,9
	78,2	91	1,1	0,6	2,5	1,5	71,5	92	93,5	1	–	5,5
	78,2	91	1,1	0,6	2,5	1,5	71,5	92	93,5	1	–	5,5
	78,2	91	1,1	0,6	2,5	–	71,5	92	93,5	1	89,7	5
	78,2	91	1,1	0,6	2,5	–	71,5	92	93,5	1	89,7	5
70	85,6	100	1,1	0,6	3	–	76,5	101	103,5	1	87,7	9,2
	85,6	100	1,1	0,6	3	–	76,5	101	103,5	1	87,7	9,2
	85,6	100	1,1	0,6	3	1,5	76,5	101	103,5	1	–	7,2
	85,6	100	1,1	0,6	3	1,5	76,5	101	103,5	1	–	7,2
	85,6	100	1,1	0,6	3	–	76,5	101	103,5	1	98,5	6,7
	85,6	100	1,1	0,6	3	–	76,5	101	103,5	1	98,5	6,7
75	90,6	105	1,1	0,6	3	–	81,5	106	108,5	1	92,7	9,6
	90,6	105	1,1	0,6	3	–	81,5	106	108,5	1	92,7	9,6
	90,6	105	1,1	0,6	3	1,5	81,5	106	108,5	1	–	7,7
	90,6	105	1,1	0,6	3	1,5	81,5	106	108,5	1	–	7,7
	90,6	105	1,1	0,6	3	–	81,5	106	108,5	1	103,5	7,1
	90,6	105	1,1	0,6	3	–	81,5	106	108,5	1	103,5	7,1
80	97	113	1,1	0,6	3	–	86,5	114	118,5	1	99,3	13
	97	113	1,1	0,6	3	–	86,5	114	118,5	1	99,3	13
	97	113	1,1	0,6	3	1	86,5	114	118,5	1	–	9,8
	97	113	1,1	0,6	3	1	86,5	114	118,5	1	–	9,8
	97	113	1,1	0,6	3	–	86,5	114	118,5	1	111,4	9
	97	113	1,1	0,6	3	–	86,5	114	118,5	1	111,4	9
85	102	118	1,1	0,6	3	1	91,5	119	123,5	1	–	10
	102	118	1,1	0,6	3	1	91,5	119	123,5	1	–	10
	102	118	1,1	0,6	3	–	91,5	119	123,5	1	116,5	9,2
	102	118	1,1	0,6	3	–	91,5	119	123,5	1	116,5	9,2
90	109,4	127	1,5	1	3	1	98	129	132	1,5	–	14
	109,4	127	1,5	1	3	1	98	129	132	1,5	–	14
	109,4	127	1,5	1	3	–	98	129	132	1,5	125,4	12
	109,4	127	1,5	1	3	–	98	129	132	1,5	125,4	12

¹⁾ For calculating the initial grease fill → **page 101**

²⁾ Permissible axial displacement from the normal position of one bearing ring relative to the other.

³⁾ For bearings equipped with a TNHA cage, contact the SKF application engineering service.

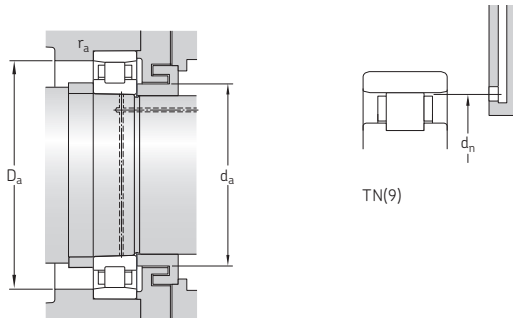
3.1 Single row cylindrical roller bearings
d 95 – 120 mm



TN(9)

TNHA

Principal dimensions			Basic load ratings		Fatigue load limit	Attainable speeds		Mass	Designation
d	D	B	dynamic C	static C ₀	P _u	Grease lubrica- tion	Oil-air lubrication		Bearing with a tapered bore
mm			kN		kN	r/min		kg	–
95	145	24	80,9	112	13,4	10 000	14 000	1,25	N 1019 KTNHA/SP
	145	24	80,9	112	13,4	11 000	15 000	1,1	N 1019 KTNHA/HC5SP
	145	24	84,2	116	14	6 700	7 500	1,25	N 1019 KTN9/SP
	145	24	84,2	116	14	8 000	9 000	1,1	N 1019 KTN9/HC5SP
100	150	24	85,8	120	14,3	9 500	13 000	1,3	N 1020 KTNHA/SP
	150	24	85,8	120	14,3	11 000	15 000	1,15	N 1020 KTNHA/HC5SP
	150	24	88	125	14,6	6 700	7 500	1,3	N 1020 KTN9/SP
	150	24	88	125	14,6	7 500	8 500	1,15	N 1020 KTN9/HC5SP
105	160	26	108	146	17,3	9 000	13 000	1,65	N 1021 KTNHA/SP
	160	26	108	146	17,3	10 000	14 000	1,45	N 1021 KTNHA/HC5SP
	160	26	110	153	18	6 300	7 000	1,65	N 1021 KTN9/SP
	160	26	110	153	18	7 000	8 000	1,45	N 1021 KTN9/HC5SP
110	170	28	125	173	20	8 500	12 000	2,05	N 1022 KTNHA/SP
	170	28	125	173	20	9 500	13 000	1,8	N 1022 KTNHA/HC5SP
	170	28	128	180	20,8	5 600	6 300	2,05	N 1022 KTN9/SP
	170	28	128	180	20,8	6 700	7 500	1,8	N 1022 KTN9/HC5SP
120	180	28	130	186	21,2	8 000	11 000	2,2	N 1024 KTNHA/SP
	180	28	130	186	21,2	9 000	12 000	1,9	N 1024 KTNHA/HC5SP
	180	28	134	196	22	5 300	6 000	2,2	N 1024 KTN9/SP
	180	28	134	196	22	6 300	7 000	1,9	N 1024 KTN9/HC5SP



TN(9)

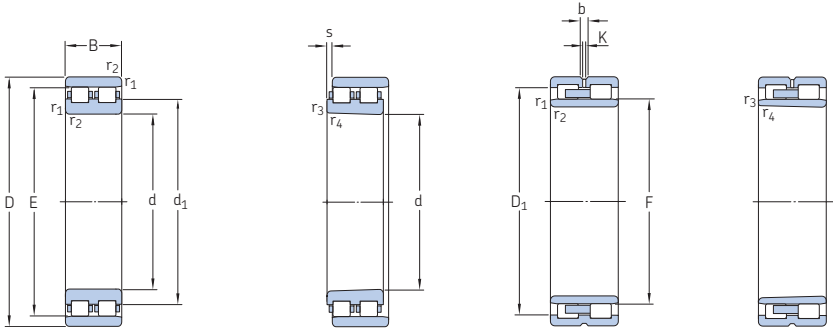
Dimensions							Abutment and fillet dimensions					Reference grease quantity ¹⁾ G _{ref}
d	d ₁	E	r _{1,2} min.	r _{3,4} min.	s ²⁾	s ₁ ²⁾	d _a min.	D _a min.	D _a max.	r _a max.	d _n ³⁾	
mm							mm					cm ³
95	114,4	132	1,5	1	3	1	103	134	137	1,5	–	14
	114,4	132	1,5	1	3	1	103	134	137	1,5	–	14
	114,4	132	1,5	1	3	–	103	134	137	1,5	130,3	13
	114,4	132	1,5	1	3	–	103	134	137	1,5	130,3	13
100	119,4	137	1,5	1	3	1	108	139	142	1,5	–	14
	119,4	137	1,5	1	3	1	108	139	142	1,5	–	14
	119,4	137	1,5	1	3	–	108	139	142	1,5	135,3	13
	119,4	137	1,5	1	3	–	108	139	142	1,5	135,3	13
105	125,2	146	2	1,1	3	1	114	148	151	2	–	18
	125,2	146	2	1,1	3	1	114	148	151	2	–	18
	125,2	146	2	1,1	3	–	114	148	151	2	144,1	18
	125,2	146	2	1,1	3	–	114	148	151	2	144,1	18
110	132,6	155	2	1,1	3	1	119	157	161	2	–	21
	132,6	155	2	1,1	3	1	119	157	161	2	–	21
	132,6	155	2	1,1	3	–	119	157	161	2	153	21
	132,6	155	2	1,1	3	–	119	157	161	2	153	21
120	142,6	165	2	1,1	3	1	129	167	171	2	–	34
	142,6	165	2	1,1	3	1	129	167	171	2	–	34
	142,6	165	2	1,1	3	–	129	167	171	2	162,9	22
	142,6	165	2	1,1	3	–	129	167	171	2	162,9	22

¹⁾ For calculating the initial grease fill → page 101

²⁾ Permissible axial displacement from the normal position of one bearing ring relative to the other.

³⁾ For bearings equipped with a TNHA cage, contact the SKF application engineering service.

3.2 Double row cylindrical roller bearings
d 25 – 105 mm



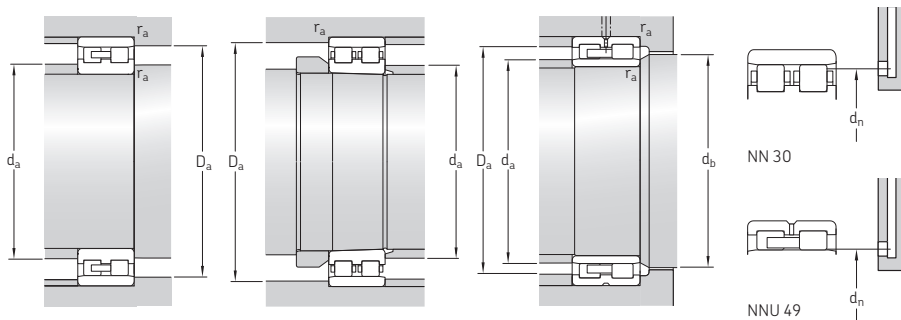
NN 30 TN(9)

NN 30 KTN(9)

NNU 49 B/W33

NNU 49 BK/W33

Principal dimensions			Basic load ratings		Fatigue load limit	Attainable speeds		Mass	Designations	cylindrical bore
d	D	B	dynamic C	static C ₀	P _u	Grease lubrication	Oil-air lubrication		Bearing with a tapered bore	
mm			kN		kN	r/min		kg	–	
25	47	16	26	30	3,15	19 000	22 000	0,12	NN 3005 K/SP	NN 3005/SP
30	55	19	30,8	37,5	4	17 000	19 000	0,19	NN 3006 KTN/SP	NN 3006 TN/SP
35	62	20	39,1	50	5,4	14 000	16 000	0,25	NN 3007 K/SP	NN 3007/SP
40	68	21	42,9	56	6,4	13 000	15 000	0,3	NN 3008 KTN/SP	NN 3008 TN/SP
45	75	23	50,1	65,5	7,65	12 000	14 000	0,38	NN 3009 KTN/SP	NN 3009 TN/SP
50	80	23	52,8	73,5	8,5	11 000	13 000	0,42	NN 3010 KTN/SP	NN 3010 TN/SP
55	90	26	69,3	96,5	11,6	10 000	12 000	0,62	NN 3011 KTN/SP	NN 3011 TN/SP
60	95	26	73,7	106	12,7	9 500	11 000	0,66	NN 3012 KTN/SP	NN 3012 TN/SP
65	100	26	76,5	116	13,7	9 000	10 000	0,71	NN 3013 KTN/SP	NN 3013 TN/SP
70	110	30	96,8	150	17,3	8 000	9 000	1	NN 3014 KTN/SP	NN 3014 TN/SP
75	115	30	96,8	150	17,6	7 500	8 500	1,1	NN 3015 KTN/SP	NN 3015 TN/SP
80	125	34	119	186	22	7 000	8 000	1,5	NN 3016 KTN/SP	NN 3016 TN/SP
85	130	34	125	204	23,2	6 700	7 500	1,55	NN 3017 KTN9/SP	NN 3017 TN9/SP
90	140	37	138	216	26	6 300	7 000	1,95	NN 3018 KTN9/SP	NN 3018 TN9/SP
95	145	37	142	232	27,5	6 000	6 700	2,05	NN 3019 KTN9/SP	NN 3019 TN9/SP
100	140	40	128	255	29	5 600	6 300	1,9	NNU 4920 BK/SPW33	NNU 4920 B/SPW33
	150	37	151	250	29	5 600	6 300	2,1	NN 3020 KTN9/SP	NN 3020 TN9/SP
105	145	40	130	260	30	5 300	6 000	2	NNU 4921 BK/SPW33	NNU 4921 B/SPW33
	160	41	190	305	36	5 300	6 000	2,7	NN 3021 KTN9/SP	NN 3021 TN9/SP



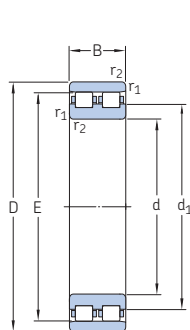
Dimensions									Abutment and fillet dimensions							Reference grease quantity ¹⁾ G _{ref}
d	d ₁ , D ₁	E, F	b	K	r _{1,2} min.	r _{3,4} min.	s ²⁾	d _a min.	d _a max.	d _b min.	D _a min.	D _a max.	r _a max.	d _n		
mm								mm							cm ³	
25	33,7	41,3	–	–	0,6	0,3	1	29	–	–	42	43	0,6	40,5	0,9	
30	40,1	48,5	–	–	1	0,6	1,5	35	–	–	49	50	1	47,6	1	
35	45,8	55	–	–	1	0,6	1,5	40	–	–	56	57	1	54	1,9	
40	50,6	61	–	–	1	0,6	1,5	45	–	–	62	63	1	60	1,8	
45	56,3	67,5	–	–	1	0,6	1,5	50	–	–	69	70	1	66,4	2,4	
50	61,3	72,5	–	–	1	0,6	1,5	55	–	–	74	75	1	71,4	2,7	
55	68,2	81	–	–	1,1	0,6	1,5	61,5	–	–	82	83,5	1	79,8	3,6	
60	73,3	86,1	–	–	1,1	0,6	1,5	66,5	–	–	87	88,5	1	85	3,8	
65	78,2	91	–	–	1,1	0,6	1,5	71,5	–	–	92	93,5	1	89,7	4,1	
70	85,6	100	–	–	1,1	0,6	2	76,5	–	–	101	103,5	1	98,5	5,9	
75	90,6	105	–	–	1,1	0,6	2	81,5	–	–	106	108,5	1	103,5	6,3	
80	97	113	–	–	1,1	0,6	2	86,5	–	–	114	118,5	1	111,4	8,3	
85	102	118	–	–	1,1	0,6	2	91,5	–	–	119	123,5	1	116,5	8,4	
90	109,4	127	–	–	1,5	1	2	98	–	–	129	132	1,5	125,4	11	
95	114,4	132	–	–	1,5	1	2	103	–	–	134	137	1,5	130,3	12	
100	125,8	113	5,5	3	1,1	0,6	1,1	106	111	116	–	133,5	1	113,8	13	
	119,4	137	–	–	1,5	1	2	108	–	–	139	142	1,5	135,3	12	
105	130,8	118	5,5	3	1,1	0,6	1,1	111	116	121	–	138,5	1	119	15	
	125,2	146	–	–	2	1,1	2	115	–	–	148	150	2	144,1	17	

¹⁾ For calculating the initial grease fill → **page 101**

²⁾ Permissible axial displacement from the normal position of one bearing ring relative to the other.

3.2 Double row cylindrical roller bearings

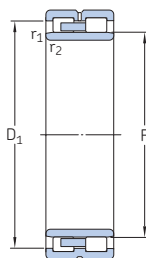
d 110 – 240 mm



NN 30 TN9



NN 30 K/W33

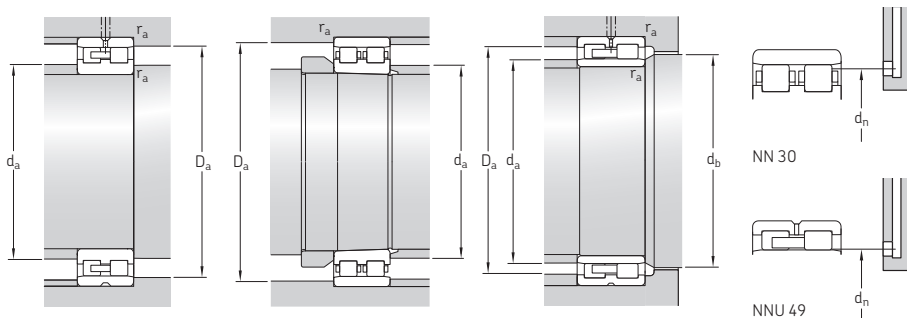


NNU 49 B/W33



NNU 49 BK/W33

Principal dimensions			Basic load ratings		Fatigue load limit	Attainable speeds		Mass	Designations		cylindrical bore
d	D	B	dynamic C	static C ₀	P _u	Grease lubrica- tion	Oil-air lubrica- tion	kg	Bearing with a tapered bore		
mm			kN		kN	r/min			–		
110	150	40	132	270	30	5 300	6 000	2,05	NNU 4922 BK/SPW33	NNU 4922 B/SPW33	
	170	45	220	360	41,5	5 000	5 600	3,4	NN 3022 KTN9/SP	NN 3022 TN9/SP	
120	165	45	176	340	37,5	4 800	5 300	2,8	NNU 4924 BK/SPW33	NNU 4924 B/SPW33	
	180	46	229	390	44	4 800	5 300	3,7	NN 3024 KTN9/SP	NN 3024 TN9/SP	
130	180	50	187	390	41,5	4 300	4 800	3,85	NNU 4926 BK/SPW33	NNU 4926 B/SPW33	
	200	52	292	500	55	4 300	4 800	5,55	NN 3026 KTN9/SP	NN 3026 TN9/SP	
140	190	50	190	400	41,5	4 000	4 500	4,1	NNU 4928 BK/SPW33	NNU 4928 B/SPW33	
	210	53	297	520	56	4 000	4 500	6	NN 3028 K/SPW33	–	
150	210	60	330	655	71	3 800	4 300	6,25	NNU 4930 B/SPW33	NNU 4930 BK/SPW33	
	225	56	330	570	62	3 800	4 300	7,3	NN 3030 K/SPW33	–	
160	220	60	330	680	72	3 600	4 000	6,6	NNU 4932 BK/SPW33	NNU 4932 B/SPW33	
	240	60	369	655	69,5	3 600	4 000	8,8	NN 3032 K/SPW33	–	
170	230	60	336	695	73,5	3 400	3 800	6,95	NNU 4934 BK/SPW33	NNU 4934 B/SPW33	
	260	67	457	815	83	3 200	3 600	12	NN 3034 K/SPW33	–	
180	250	69	402	850	88	3 000	3 400	10,5	NNU 4936 BK/SPW33	NNU 4936 B/SPW33	
	280	74	561	1 000	102	3 000	3 400	16	NN 3036 K/SPW33	–	
190	260	69	402	880	90	2 800	3 200	11	NNU 4938 BK/SPW33	NNU 4938 B/SPW33	
	290	75	594	1 080	108	2 800	3 200	17	NN 3038 K/SPW33	–	
200	280	80	484	1 040	106	2 600	3 000	15	NNU 4940 BK/SPW33	NNU 4940 B/SPW33	
	310	82	644	1 140	118	2 600	3 000	21	NN 3040 K/SPW33	–	
220	300	80	512	1 140	114	2 400	2 800	16,5	NNU 4944 BK/SPW33	NNU 4944 B/SPW33	
	340	90	809	1 460	143	2 400	2 800	27,5	NN 3044 K/SPW33	–	
240	320	80	528	1 220	118	2 200	2 600	17,5	NNU 4948 BK/SPW33	NNU 4948 B/SPW33	
	360	92	842	1 560	153	2 200	2 600	30,5	NN 3048 K/SPW33	–	



3.2

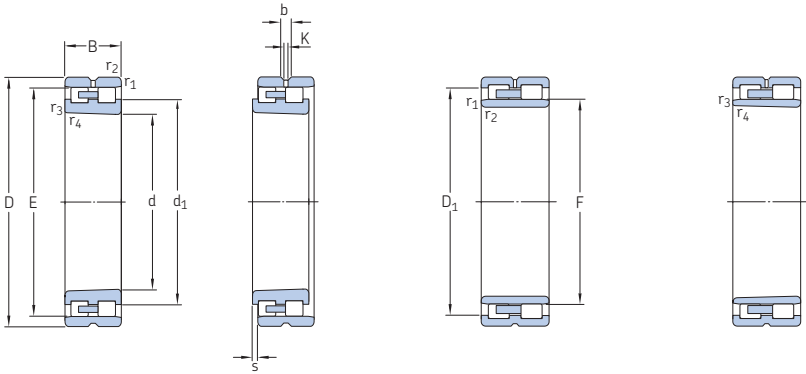
Dimensions								Abutment and fillet dimensions								Reference grease quantity ¹⁾	
d	d ₁ , D ₁	E, F	b	K	r _{1,2} min.	r _{3,4} min.	s ²⁾	d _a min.	d _a max.	d _b min.	D _a min.	D _a max.	r _a max.	d _n	G _{ref}		
mm								mm								cm ³	
110	135,8	123	5,5	3	1,1	0,6	1,1	116	121	126	–	143,5	1	124	17		
	132,6	155	–	–	2	1,1	3	120	–	–	157	160	2	153	20		
120	150,5	134,5	5,5	3	1,1	0,6	1,1	126	133	137	–	158,5	1	136,8	27		
	142,6	165	–	–	2	1,1	3	130	–	–	167	170	2	162,9	23		
130	162	146	5,5	3	1,5	1	2,2	137	144	149	–	172	1,5	147	31		
	156,4	182	–	–	2	1,1	3	140	–	–	183	190	2	179,6	34		
140	172	156	5,5	3	1,5	1	2,2	147	154	159	–	182	1,5	157	45		
	166,5	192	8,7	4,5	2	1,1	2,5	150	–	–	194	200	2	188	52		
150	190,9	168,5	5,5	3	2	1	2	160	166	172	–	200	2	169,9	57		
	179	206	8,7	4,5	2,1	1,1	2,5	161	–	–	208	214	2	201,7	63		
160	200,9	178,5	5,5	3	2	2	2	170	176	182	–	210	2	179,8	63		
	190	219	8,5	4,5	2,1	1,1	2,5	171	–	–	221	229	2	214,4	78		
170	210,9	188,5	5,5	3	2	2	2	180	186	192	–	220	2	189,8	72		
	204	236	8,9	4,5	2,1	1,1	2,5	181	–	–	238	249	2	230,8	105		
180	226,05	202	8,3	3	2	1	1,1	190	199	205	–	240	2	203,5	81		
	218,2	255	11,3	6	2,1	1,1	3	191	–	–	257	269	2	248,9	138		
190	236	212	8,3	3	2	1	1,1	200	209	215	–	250	2	213	85		
	228,2	265	11,3	6	2,1	1,1	3	201	–	–	267	279	2	258,9	144		
200	252,2	225	11,1	3	2,1	1,1	3,7	211	222	228	–	269	2	227	117		
	242	282	12,2	6	2,1	1,1	3	211	–	–	285	299	2	275,3	191		
220	272,2	245	11,1	3	2,1	1,1	3,7	231	242	249	–	289	2	247	150		
	265,2	310	15	7,5	3	1,1	2	233	–	–	313	327	2,5	302,4	260		
240	292,2	265,3	11,1	3	2,1	1,1	3,7	251	262	269	–	309	2	267	171		
	285,2	330	15,2	7,5	3	1,1	2	253	–	–	333	347	2,5	322,4	288		

¹⁾ For calculating the initial grease fill → **page 101**

²⁾ Permissible axial displacement from the normal position of one bearing ring relative to the other.

3.2 Double row cylindrical roller bearings

d 260 – 670 mm

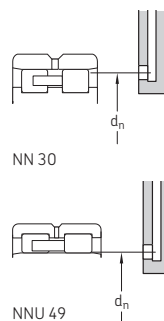
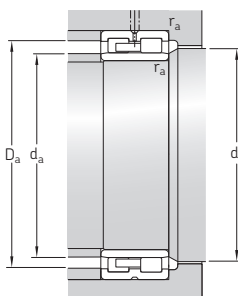
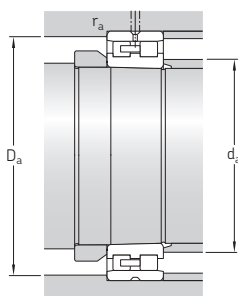


NN 30 K/W33

NNU 49 B/W33

NNU 49 BK/W33

Principal dimensions			Basic load ratings		Fatigue load limit	Attainable speeds		Mass	Designations		cylindrical bore
d	D	B	dynamic C	static C ₀	P _u	Grease lubrication	Oil-air lubrication		Bearing with a tapered bore		
mm			kN		kN	r/min		kg	–		
260	360 400	100 104	748 1 020	1 700 1 930	163 183	2 000 2 000	2 400 2 400	30,5 44	NNU 4952 BK/SPW33 NN 3052 K/SPW33	–	NNU 4952 B/SPW33
280	380 420	100 106	765 1 080	1 800 2 080	170 196	1 900 1 900	2 200 2 200	32,5 47,5	NNU 4956 BK/SPW33 NN 3056 K/SPW33	–	NNU 4956 B/SPW33
300	420 460	118 118	1 020 1 250	2 360 2 400	224 228	1 800 1 700	2 000 1 900	50 66,5	NNU 4960 BK/SPW33 NN 3060 K/SPW33	–	NNU 4960 B/SPW33
320	440 480	118 121	1 060 1 320	2 500 2 600	232 240	1 700 1 600	1 900 1 800	50 71	NNU 4964 BK/SPW33 NN 3064 K/SPW33	–	NNU 4964 B/SPW33
340	460 520	118 133	1 100 1 650	2 650 3 250	245 290	1 500 1 400	1 700 1 600	53 94,5	NNU 4968 BK/SPW33 NN 3068 K/SPW33	–	NNU 4968 B/SPW33
360	480 540	118 134	1 120 1 720	2 800 3 450	250 310	1 500 1 300	1 700 1 500	55 102	NNU 4972 BK/SPW33 NN 3072 K/SPW33	–	NNU 4972 B/SPW33
380	520 560	140 135	1 450 1 680	3 600 3 450	320 305	1 300 1 300	1 500 1 500	83,5 105	NNU 4976 BK/SPW33 NN 3076 K/SPW33	–	NNU 4976 B/SPW33
400	540 600	140 148	1 470 2 160	3 800 4 500	335 380	1 300 1 200	1 500 1 400	87,5 135	NNU 4980 BK/SPW33 NN 3080 K/SPW33	–	NNU 4980 B/SPW33
420	560 620	140 150	1 510 2 120	4 000 4 500	345 380	1 200 1 100	1 400 1 300	91 140	NNU 4984 BK/SPW33 NN 3084 K/SPW33	–	NNU 4984 B/SPW33
460	620 680	160 163	2 090 2 600	5 500 5 500	465 440	1 000 1 000	1 200 1 200	130 190	NNU 4992 BK/SPW33 NN 3092 K/SPW33	–	NNU 4992 B/SPW33
500	670	170	2 330	6 100	490	950	1 100	165	NNU 49/500 BK/SPW33X	–	NNU 49/500 B/SPW33X
600	800	200	3 580	10 200	800	800	900	280	NNU 49/600 BK/SPW33X	–	NNU 49/600 B/SPW33X
670	900	230	4 950	13 700	930	700	800	410	NNU 49/670 BK/SPW33X	–	NNU 49/670 B/SPW33X



Dimensions							Abutment and fillet dimensions								Reference grease quantity ^{1) 3)} G _{ref}	
d	d ₁ , D ₁	E, F	b	K	r _{1,2} min.	s ²⁾	d _a min.	d _a max.	d _b min.	D _a min.	D _a max.	r _a max.	d _n ³⁾			
mm							mm							cm ³		
260	325,6	292	13,9	3	2,1	1,1	4,5	271	288	296	–	349	2	294,5	366	
	312,8	364	15,3	7,5	4	1,5	5	275	–	–	367	384	3	355,2	392	
280	345,6	312	13,9	3	2,1	1,1	4,5	291	308	316	–	369	2	313,5	384	
	332,8	384	15,3	7,5	4	1,5	5	295	–	–	387	404	3	375,3	420	
300	379	339	16,7	3	3	1,1	5,5	313	335	343	–	407	2,5	362	420	
	359	418	16,7	9	4	2	8,9	315	–	–	421	445	3	–	–	
320	399	359	16,7	9	3	2	5,5	333	355	363	–	427	2,5	–	–	
	379	438	16,7	9	4	2	8,9	335	–	–	442	465	3	–	–	
340	419	379	16,7	9	3	1,5	5,5	353	375	383	–	447	2,5	–	–	
	408	473	16,7	9	5	3	10,9	358	–	–	477	502	4	–	–	
360	439	399	16,7	9	3	1,5	5,5	373	395	403	–	467	2,5	–	–	
	428	493	16,7	9	5	2,5	10,9	378	–	–	497	520	4	–	–	
380	470,8	426	16,7	9	4	2,5	5,5	395	421	431	–	505	3	–	–	
	448	513	16,7	9	5	2,5	11,9	398	–	–	517	542	4	–	–	
400	490,8	446	16,7	9	4	2,5	5,5	415	441	451	–	524	3	–	–	
	475	549	16,7	9	5	2,5	12,4	418	–	–	553	582	4	–	–	
420	510,5	466	16,7	9	4	2	5,5	435	461	471	–	544	3	–	–	
	495	569	16,7	9	5	2	12,4	438	–	–	574	602	4	–	–	
460	567	510	16,7	9	4	2	3,2	475	504	515	–	605	3	–	–	
	542	624	22,3	12	6	3	14,4	483	–	–	627	657	5	–	–	
500	611,6	554	22,3	12	5	3	3,5	548	548	559	–	652	4	–	–	
600	733,2	666	22,3	12	5	2,5	5,5	648	662	672	–	782	4	–	–	
670	821,2	738	22,3	12	6	3	6	693	732	744	–	877	5	–	–	

¹⁾ For calculating the initial grease fill → page 101

²⁾ Permissible axial displacement from the normal position of one bearing ring relative to the other.

³⁾ For bearings with D > 420 mm, contact the SKF application engineering service.