

Needle roller and cage assemblies



Matrix for bearing preselection 855

1 Needle roller and cage assemblies **856**

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Matrix for bearing preselection

The matrix gives an overview of the types and design features of needle roller and cage assemblies.

It can be used to make a preliminary assessment of whether a bearing is fundamentally suitable for the envisaged application.

The additional information provided in the product chapter (see column "detailed information") and in the Technical principles must, however, be observed in addition to this overview in selection of the bearing.

Design features and suitability			Needle roller and cage assemblies	
			single or double row	detailed information
+++ extremely suitable ++ highly suitable + suitable (+) suitable with restrictions – not suitable/not applicable ✓ available				856
Load carrying capacity	radial		+++	➤ 861 1.2
	axial, one direction		–	➤ 861 1.2
	axial, both directions		–	➤ 861 1.2
	moments		–	➤ 861 1.2
Compensation of angular misalignments	static		–	➤ 861 1.3
	dynamic		–	➤ 861 1.3
Bearing design	cylindrical bore		–	➤ 856 1.1
	tapered bore		–	➤ 856 1.1
	separable		–	➤ 869 1.17
Lubrication	greased		–	➤ 862 1.4
Sealing	open		✓	➤ 862 1.5
	non-contact		–	➤ 862 1.5
	contact		–	➤ 862 1.5
Operating temperature in °C		from to	–30 +140 ¹⁾	➤ 863 1.8
Suitability for	high speeds		+++	➤ 862 1.6
	high running accuracy		++	➤ 864 1.11 ➤ 114
	low-noise running		+	➤ 862 1.7 ➤ 27
	high rigidity		++	➤ 54
	reduced friction		+	➤ 56
	length compensation within bearing		–	
	non-locating bearing arrangement		++	➤ 139
	locating bearing arrangement		–	➤ 139
X-life bearings		X-life	–	
Enveloping circle diameter F _w in mm		from to	3 265	➤ 872
Product tables		from page		872

¹⁾ Data valid for needle roller and cage assemblies with sheet steel cage and with cages made from copper-zinc alloy



1 Needle roller and cage assemblies



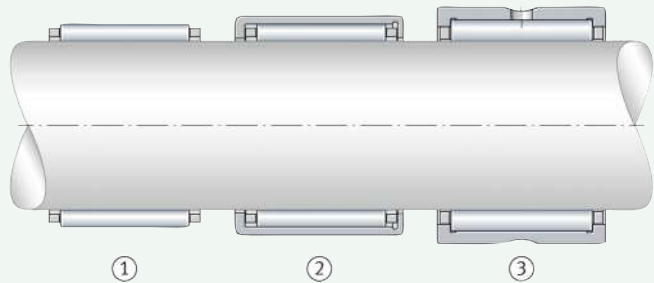
Radial needle roller and cage assemblies:

- are suitable for applications with a very small radial design envelope, where the raceways on the shaft and in the housing are designed as rolling bearing raceways (direct bearing arrangement)
- can support high radial loads
- allow high speeds
- combine the load carrying capacity advantages of full complement needle roller bearing arrangements with the speed advantages of a cage bearing
- have a high running accuracy
- result in rigid bearing arrangements
- are easy to mount
- permit technically straightforward, economical and cost-effective designs.

For an overview of other product-specific features, see the Matrix for bearing preselection ►855.

 **1**
Radial needle roller and cage assembly – comparison of radial design envelope with drawn cup needle roller bearing with open ends and machined needle roller bearing

- ① Radial needle roller and cage assembly
- ② Drawn cup needle roller bearing with open ends
- ③ Machined needle roller bearing



1.1

Bearing designs

 *Design variants*

Radial needle roller and cage assemblies:

- are available in the basic design (K) ►857| 2 and ►858| 3
- are available for centrifugal forces and high acceleration forces (KZK, KBK) ►859| 4
- can be customised from profiled strip (K) ►860| 6.

Needle roller and cage assemblies of basic design

☞ *Bearings with a very small radial section height*

Needle roller and cage assemblies are part of the group of radial needle roller bearings. These ready-to-fit bearing arrangement elements comprise needle cages, which are fitted with needle rollers ➤857|☐2 and ➤858|☐1. They are rolling bearings with a very small radial section height and, apart from full complement needle roller bearing arrangements, are the simplest design of radial needle roller bearing. However, while the design envelope is completely filled with loose needle rollers in full complement needle roller bearing arrangements and, depending on the position, the rolling elements are therefore in contact with each other, these are guided in the cage pockets in needle roller and cage assemblies. The pockets, which are separated from each other by bars and are uniformly distributed around the circumference of the cage, maintain the spacing of the rolling elements relative to each other. The cage and rolling elements thus create a ready-to-fit unit.

☞ *The needle rollers are guided parallel to the axis*

In addition, the bars prevent sliding friction between adjacent rolling elements and guide the rolling elements parallel to the bearing axis in the load-free zone. Guidance parallel to the axis prevents skewing of the needle rollers in the load-free zone. Compared with full complement needle roller bearing arrangements, needle roller and cage assemblies are suitable for higher speeds. As a result, the cage compensates for the disadvantages of a full complement needle roller bearing arrangement.

☞ *For bearing arrangements with a particularly small radial design envelope*

Standard needle roller sorts are used as needle rollers ➤858|☐1. Due to the absence of an inner and outer ring, the radial section height of the bearings is only equivalent to the diameter of the needle rollers. As a result, needle roller and cage assemblies are particularly suitable for applications requiring only a very small radial design envelope. The majority of the bearings are of a single row design ➤857|☐2. This variant has the prefix K.

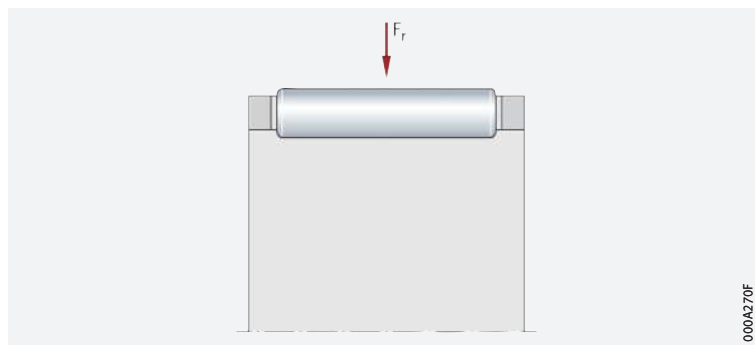


Needle roller and cage assemblies are only functional once they have been fitted between the housing and shaft. In this case, the raceways must be designed as rolling bearing raceways ➤866|1.16.



Single row needle roller and cage assembly

F_r = radial load



000A270F

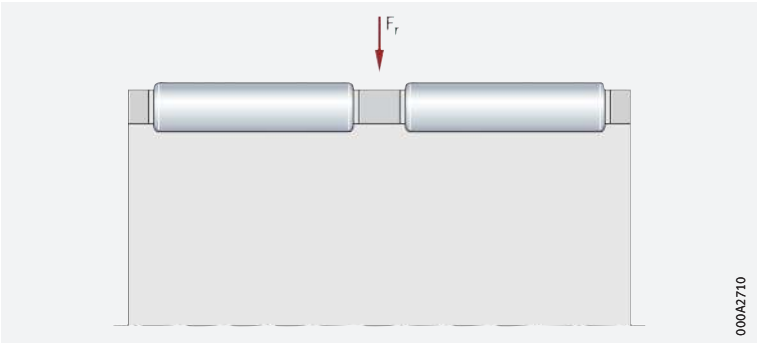
Double row needle roller and cage assemblies

☞ *Particularly high radial load carrying capacity*

Double row needle roller and cage assemblies have a higher load carrying capacity than single row designs, but are correspondingly wider ➤858|☐3. These bearings have the prefix K and the suffix ZW and are only available in particular enveloping circle diameters F_w ➤864|1.12 and ➤872|☐.



 3
Double row needle roller and cage assembly
 F_r = radial load



 Standard needle roller sorts are used as needle rollers

Needle rollers
Needle roller and cage assemblies are supplied with standard needle roller sorts of grade G2 in accordance with the table  1. In all cases, needle rollers of only one sort are used in any one needle roller and cage assembly. The sort is printed on the packaging and colour coded  1. The sorts are designated by the upper and lower deviations (in μm), the diameter tolerance is a maximum of 2 μm . In each case, two neighbouring needle roller sorts are matched as sort pairs.

 1
Dimensional and geometrical accuracy of needle rollers of grade G2

Grade	Deviations and tolerances for diameter D _w ¹⁾							Length tolerance
	Devi- ation	Variation of needle roller diameter within a single sort	Sort pair colour code	Sorts		Round- ness	Rough- ness	
	μm	V _{DwL} μm max.		μm		t _{Dw} μm max.	Ra μm max.	
G2	0 – 7	2	red	0 – 2	–1 – 3	1	0,1	h13
			blue	–2 – 4	–3 – 5			
			white (grey)	–4 – 6	–5 – 7			

¹⁾ The tolerance values apply to the centre point of the needle roller.

Needle roller and cage assemblies for centrifugal forces and high acceleration forces (KZK, KBK)

Needle roller and cage assemblies for connecting rod bearing arrangements

 Designed for piston pin and crank pin bearing arrangements

Needle roller and cage assemblies for connecting rod bearing arrangements are used in the crank mechanisms of 2 and 4 stroke combustion engines as well as in compressors, for supporting crank pins and piston pins  4. These cages support high centrifugal and acceleration forces and are suitable for high speeds.



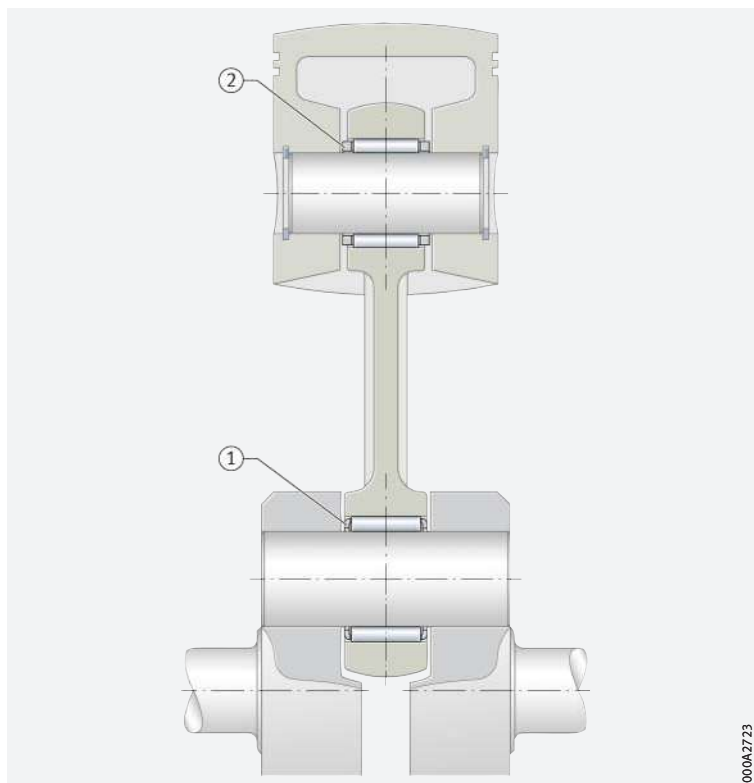
For piston pin bearing arrangements, only needle roller and cage assemblies with the designation KZK and KBK may be used  TPI 94. As catalogue needle roller and cage assemblies of type K are not designed to accommodate loads generated by centrifugal forces and high acceleration forces, non-compliance may result in failures.



The needle roller and cage assemblies for piston pin and crank pin bearing arrangements are described in detail in Technical Product Information TPI 94. This publication can be requested from Schaeffler.

4 Crank pin and piston pin bearing arrangement

- ① Needle roller and cage assembly for crank pins, externally guided
- ② Needle roller and cage assembly for piston pins, internally guided



Needle roller and cage assemblies for crank pins (KZK)

Needle roller and cage assemblies for crank pins (series KZK) are externally guided, which means that the connecting rod bore guides the cage radially with little clearance ► 859 |  4. The radial movement of the cage in relation to the connecting rod bore and the rolling elements is as small as possible. The cages are made from quenched and tempered steel, have good wear resistance, high strength and large guidance surfaces which are designed for optimum lubrication.

Needle roller and cage assemblies for piston pins (KBK)

The needle roller and cage assemblies for piston pins (series KBK) are internally guided, which means that the piston pin guides the cage radially with little clearance ► 859 |  4. Due to the small radial internal clearance, tilting of the connecting rod is reduced to a minimum. The bearings support high-frequency oscillating loads and are available for the majority of piston pin diameters in various widths, in accordance with the spacing between the piston centres. The low-wear steel cages are case hardened or quenched and tempered and have high strength.

Needle roller and cage assemblies for planetary gear bearing arrangements (KZK)

Needle roller and cage assemblies for planetary gear bearing arrangements

Needle roller and cage assemblies are also used for applications in planetary gear bearing arrangements, such as automatic gearboxes ► 860 |  5. As very high speeds, as well as centrifugal and acceleration forces, can occur in planetary gear bearing arrangements and the cage is therefore subject to high demands, the responsible Application Engineering and Design functions should select or design a suitable needle roller and cage assembly. In such cases, please consult Schaeffler.



 5
Planetary gear
bearing arrangement



000A5DEB

 **Customised radial
needle roller and
cage assemblies
for specific requirements**

Needle roller and cage assemblies customised from profiled strip (K)

These radial needle roller and cage assemblies are produced by bending flat cages BF and fitted with needle rollers after forming ►860|  6. As a result, it is possible to achieve simple designs of clearance-free bearing arrangements with high running accuracy, load carrying capacity and speed suitability, in combination with very small radial and axial section height. Due to their high radial runout accuracy, the bearings are also suitable for precision applications. Since the needle roller and cage assemblies are not tied to defined dimension series but can be precisely produced to a wide range of diameter values in accordance with the specific application (shaft diameter of 105 mm to 1000 mm), they are an economical alternative to catalogue standard bearings. They are normally supplied bent into their final shape but can also be formed by the customer from BF flat cages. After forming, there is an open joint ►860|  6. As a result, radial needle roller and cage assemblies can be easily mounted in recessed raceways. The function of the cages is not impaired by the opening.



BF flat cages and radial needle roller and cage assemblies produced from BF flat cages are described in detail in Technical Product Information TPI 203. This publication can be requested from Schaeffler.

 6
Radial needle roller and
cage assembly produced
by bending from a flat cage BF

 Open joint



000A38EA

1.2 Load carrying capacity

☞ *Capable of supporting high radial loads, but not axial loads*

Due to the line contact of the needle rollers, needle roller and cage assemblies are suitable for supporting high radial loads. In contrast to the ball, the needle has a larger contact area perpendicular to its axis. As a result, it can transmit higher forces, has greater rigidity and can support the same loads with smaller rolling element diameters. Due to the needle roller set, double row bearings have a particularly high radial load carrying capacity. They are used when the load carrying capacity of single row bearings is no longer sufficient.



Needle roller and cage assemblies cannot support axial forces

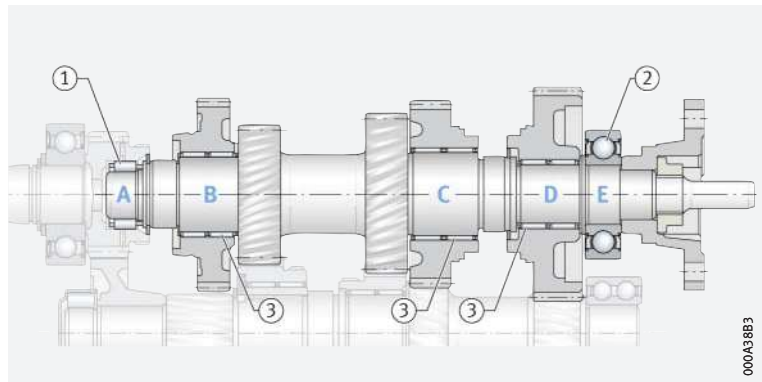
► 865 | 1.14. For axial loads, they can be combined with a bearing which is capable of supporting axial load, such as a deep groove ball bearing or a cylindrical roller bearing with axial load carrying capacity. In such cases, the axial bearing is arranged adjacent to the needle roller and cage assembly ► 861 | 7.



7
Passenger car gearbox:
bearing arrangement
of main shaft

A – E = bearing positions

- ① Cylindrical roller bearing and cage assembly as pilot bearing (non-locating bearing)
- ② Deep groove ball bearing (locating bearing, capable of supporting axial loads)
- ③ Needle roller and cage assemblies (non-locating bearing, capable of supporting radial loads only)



1.3 Compensation of angular misalignments

☞ *The bearings are not suitable for the compensation of shaft misalignments relative to the housing bore*

Needle roller and cage assemblies are not suitable for the compensation of angular misalignments. The extent to which a misalignment of the shaft can be tolerated relative to the housing bore is dependent on factors such as the design of the bearing arrangement, the size of the bearing, the operating clearance and the load. As a result, no guide value can be specified here for a possible misalignment.



In all cases, misalignments cause increased running noise, place increased strain on the cages and have a harmful influence on the operating life of the bearings.



1.4 Lubrication

☞ *Oil or grease lubrication is possible*

Needle roller and cage assemblies are not greased. In order to prevent direct metallic contact between rolling elements, raceways and cages, they must be lubricated. Oil or grease lubrication is suitable. The lubricant reduces the wear and also protects the surfaces against corrosion. The choice of lubricant is essentially dependent on the operating temperatures and speeds, but is also influenced by other factors.

☞ *The use of oil lubrication is preferred*

For most applications involving needle roller and cage assemblies, oil should be used in preference as the lubricant.

☞ *Compatibility with plastic cages*

When using bearings with plastic cages, compatibility between the lubricant and the cage material must be ensured if synthetic oils, lubricating greases with a synthetic oil base or lubricants containing a high proportion of EP additives are used.

☞ *Observe oil change intervals*

Aged oil and additives in the oil can impair the operating life of plastics at high temperatures. As a result, stipulated oil change intervals must be strictly observed.



If there is any uncertainty regarding the suitability of the selected lubricant for the application, please consult Schaeffler or the lubricant manufacturer.

1.5 Sealing

☞ *The bearings are of an open design*

Needle roller and cage assemblies are supplied without seals. As a result, sealing of the bearing position must be carried out in the adjacent construction. This must reliably prevent:

- moisture and contaminants from entering the bearing
- the egress of lubricant from the bearing position.

1.6 Speeds

☞ *Limiting speeds and reference speeds in the product tables*

The product tables give two speeds for the bearings ►872|:

- the kinematic limiting speed n_G
- the thermal speed rating n_{Gr} .



The limiting speed n_G is the kinematically permissible speed of a bearing. Even under favourable mounting and operating conditions, this value should not be exceeded without prior consultation with Schaeffler ►64. The values in the product tables are valid for oil lubrication.

☞ *Values for grease lubrication*

For grease lubrication, 60% of the value stated in the product tables is permissible in each case.

Reference speeds

☞ *n_{Gr} is used to calculate n_{θ}*

The thermal speed rating n_{Gr} is not an application-oriented speed limit, but is a calculated ancillary value for determining the thermally safe operating speed n_{θ} ►64.

1.7 Noise

Schaeffler Noise Index

The Schaeffler Noise Index (SGI) is not yet available for this bearing type ►69. The data for these bearing series will be introduced and updated in stages.

Further information:

- **medias** ► <https://medias.schaeffler.com>.

1.8 Temperature range

 Limiting values

The operating temperature of the bearings is limited by:

- the dimensional stability of the rolling elements
- the cage
- the lubricant.

Possible operating temperatures of needle roller and cage assemblies

►863| 2.

 2
Permissible temperature ranges

Operating temperature	Needle roller and cage assemblies	
	with plastic cage	with sheet steel cage and with cages made from copper-zinc alloy
	-20 °C to +120 °C	-30 °C to +140 °C



In the event of anticipated temperatures which lie outside the stated values, please contact Schaeffler.

1.9 Cages

 The standard cages are made from sheet steel

The standard cages are made from sheet steel and, with an enveloping circle diameter $F_w \geq 195$ mm, from a copper-zinc alloy. Bearings with a plastic cage are only available in particular sizes and have the suffix TV ►864| 3 and ►872|. Other cages are available by agreement. With such cages, however, suitability for high speeds and temperatures as well as the basic load ratings may differ from the values for the bearings with standard cages.



For high continuous temperatures and applications with difficult operating conditions, bearings with sheet steel cages should be used. If there is any uncertainty regarding cage suitability, please consult Schaeffler.

1.10 Internal clearance

 Influencing factors on the radial internal clearance

Radial internal clearance

The radial internal clearance can be influenced by the needle roller sort as well as by the shaft and housing tolerances. When standard needle roller sorts are used, a radial internal clearance of C2 to CN is achieved (radial internal clearance for needle and cylindrical roller bearings to DIN 620-4), if the shaft and housing tolerances are observed ►866| 4 and normal operating conditions are present. If the actual dimensions have a plus tolerance, a radial internal clearance of 0 can be achieved.

 F_w can only be checked in a mounted condition

Checking the enveloping circle diameter

The outer and inner enveloping circle diameters E_w and F_w cannot be measured in an unmounted condition. As a result, the function of the bearings is checked using plug gauges and locating rings in accordance with the methods indicated in DIN 620-1/ISO 1132-2. In order to carry out the check, the needle roller and cage assemblies are placed in a locating ring, which corresponds to the specific nominal dimension E_w of the needle roller and cage assembly. The function of the needle roller and cage assembly is ensured if the plug gauge, which corresponds to the nominal dimension F_w , can be inserted and rotated without jamming.



1.11 Dimensions, tolerances

Dimension standards



The main dimensions of single row needle roller and cage assemblies correspond to DIN 5405-1:2016 and ISO 3030:2011, where standardised.

Tolerances

Needle rollers

The needle rollers correspond to DIN 5402-3:2012 and ISO 3096:1996. The diameters of all needle rollers in a needle roller and cage assembly lie within the tolerance of 2 µm ➤863|2.

Width B_c

The deviations for cage width B_c are as follows for all needle roller and cage assemblies: B_c -0,2/-0,8 ➤872|

1.12 Suffixes

For a description of the suffixes used in this chapter ➤864|3 and medias interchange ➤<https://www.schaeffler.de/std/1D52>.

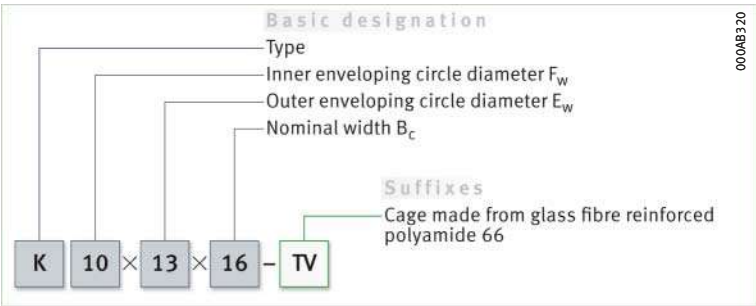
3
Suffixes and
corresponding descriptions

Suffix	Description of suffix	
TV	Cage made from glass fibre reinforced polyamide PA66	Standard
ZW	Double row design (only available in certain enveloping circle diameters)	

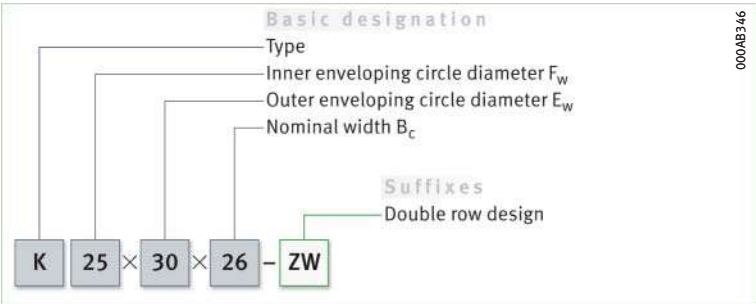
1.13 Structure of bearing designation

The designation of bearings follows a set model. Examples ➤864|8 and ➤864|9. The composition of designations is subject to DIN 623-1 ➤102|10.

8
Single row needle roller and
cage assembly:
designation structure



9
Double row needle roller and
cage assembly:
designation structure



1.14

Dimensioning

 $P = F_r$ under purely radial load of constant magnitude and direction



Equivalent dynamic bearing load

The basic rating life equation $L = (C_r/P)^P$ used in the dimensioning of bearings under dynamic load assumes a load of constant magnitude and direction. In radial bearings, this is a purely radial load F_r . If this condition is met, the bearing load F_r is used in the rating life equation for P ($P = F_r$).

Needle roller and cage assemblies can only support radial loads. Thus, for these bearings ➤ 865 |  1.

 1

Equivalent dynamic load

Legend

$$P = F_r$$

P	N	Equivalent dynamic bearing load
F_r	N	Radial load.

Equivalent static bearing load

For needle roller and cage assemblies subjected to static load ➤ 865 |  2.

 2

Equivalent static load

Legend

$$P_0 = F_{0r}$$

P_0	N	Equivalent static bearing load
F_{0r}	N	Largest radial load present (maximum load).

Static load safety factor

 $S_0 = C_0/P_0$ In addition to the basic rating life $L (L_{10h})$, it is also always necessary to check the static load safety factor S_0 ➤ 865 |  3.

 3

Static load safety factor

Legend

$$S_0 = \frac{C_0}{P_0}$$

S_0	–	Static load safety factor
C_0	N	Basic static load rating
P_0	N	Equivalent static bearing load.

1.15

Minimum load

 In order to prevent damage due to slippage, a minimum radial load of $P > C_{0r}/60$ is required



In order that no slippage occurs between the contact partners, the needle roller and cage assemblies must be constantly subjected to a sufficiently high load. Based on experience, a minimum radial load of the order of $P > C_{0r}/60$ is thus necessary. In most cases, however, the radial load is already higher than the requisite minimum load due to the weight of the supported parts and the external forces.

If the minimum radial load is lower than indicated above, please consult Schaeffler.



1.16 Design of bearing arrangements



The shaft and housing design and the lateral restriction (axial location) of the bearing position is crucial to the correct function of needle roller and cage assemblies ➤ 866 | 4, ➤ 867 | 10 and ➤ 867 | 11.

Raceways for bearings without bearing rings (direct bearing arrangement)

☞ *Produce the raceway as a rolling bearing raceway*

If the needle roller and cage assemblies run directly on the shaft and/or in the housing bore (so-called direct bearing arrangement), then the raceway for the rolling elements on the shaft and in the housing must be produced as a rolling bearing raceway (hardened and ground). Design of raceways ➤ 866 | 4. The surface hardness of the raceways must be 670 HV to 840 HV, the hardening depth CHD or SHD must be sufficiently large. The values in the table refer to commonly encountered application examples. If the shaft cannot be produced as a raceway, the needle roller and cage assemblies can be combined with Schaeffler bearing rings. However, the section height of the bearings will then be increased by the thickness of the rings.

4
Tolerance classes and surface design of raceways for needle roller and cage assemblies (direct bearing arrangement)

Shaft diameter		Bore tolerance ¹⁾	Shaft tolerance ¹⁾			Design of raceway		
			Operating clearance			Recommended mean roughness value R _{amax} (R _{zmax})	Roundness tolerance	Parallelism tolerance
			small	normal	large	μm	max.	max.
–	80	G6	j5	h5	g6	0,2 (1)	IT3	IT3
		H6	h5	g5	f6			
80	120	G6	h5	g5	f6	0,3 (1,6)		
120	–	G6	h5	g5	f6	0,4 (2,5)		
		H6	–	f5	e6			

¹⁾ The envelope requirement ☉ applies.

Raceway width for direct bearing arrangement and axial running surfaces

☞ *Mounting dimensions for needle roller and cage assemblies and surface quality of the running surfaces*

The raceway width must be at least equal to the nominal width B_c (B_c is produced with a (–) tolerance); values for B_c ➤ 872 | 4 and ➤ 867 | 10. The spacing between the axial running surfaces of the cage must be sufficiently large. The spacing dimension for running surfaces is given as B_c H12 ☉, in order to avoid jamming of the needle roller and cage assemblies (H12 in accordance with ISO 286-2). The lateral running surfaces for the needle roller and cage assemblies must be designed as precision machined (R_{amax} 2 recommended) and wear-resistant ➤ 867 | 10. Interruptions in the running surfaces should be avoided.

☞ *Example* For a design envelope of $B_c = 10$ mm, a needle roller and cage assembly with the nominal width $B_c = 10$ mm is suitable, as the maximum cage width is 9,8 (0/–0,6) mm.

10

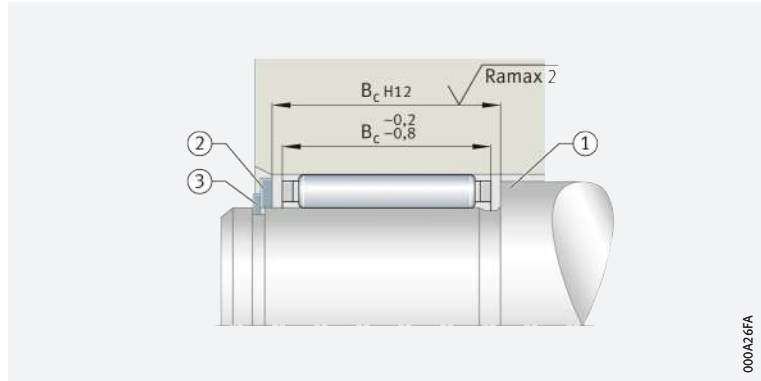
Raceway width and axial running surfaces for needle roller and cage assemblies

$B_c H12$ = nominal width

$B_c -0,2 / -0,8$ = cage width

Ramax = maximum roughness of running surfaces

- ① Location by means of shaft shoulder, axial washer and snap ring
- ② Axial washer
- ③ Snap ring



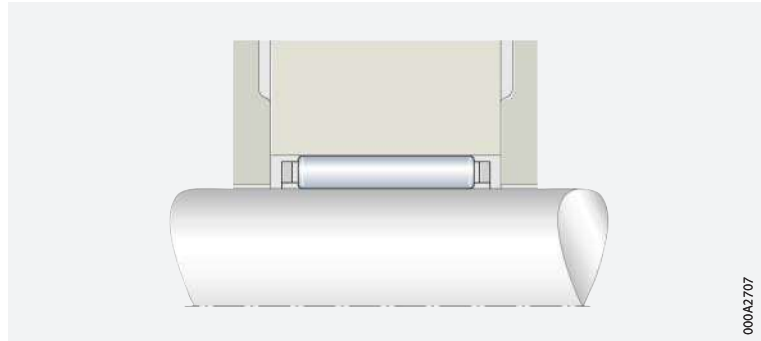
Axial guidance and location of needle roller and cage assemblies

Guidance can be provided by the shaft or on the housing

Needle roller and cage assemblies must be axially guided and located. Guidance can be provided by the shaft or on the housing ► 867 | 10 and ► 867 | 11. Snap rings or an appropriately designed adjacent construction are suitable for this purpose. If location is by means of snap rings or retaining rings, a washer must be arranged in front of the rings ► 867 | 10. The overlap between the ring and washer must be sufficiently large.

11

Axial location by means of housing parts (lateral guidance on housing)



Steels for the raceway (direct bearing arrangement)

Through hardening steels



Through hardening steels in accordance with ISO 683-17 (e.g. 100Cr6) are suitable as materials for rolling bearing raceways in direct bearing arrangements. These steels can also be surface layer hardened.

Case hardening steels



Case hardening steels must correspond to DIN EN ISO 683-17 (e.g. 17MnCr5, 18CrNiMo7-6) or EN 10084 (e.g. 16MnCr5).

Steels for inductive surface layer hardening



For flame and induction hardening, steels in accordance with DIN EN ISO 683-17 (e.g. C56E2, 43CrMo4) or DIN 17212 (e.g. Cf53) should be used.



Raceway hardness of less than 670 HV

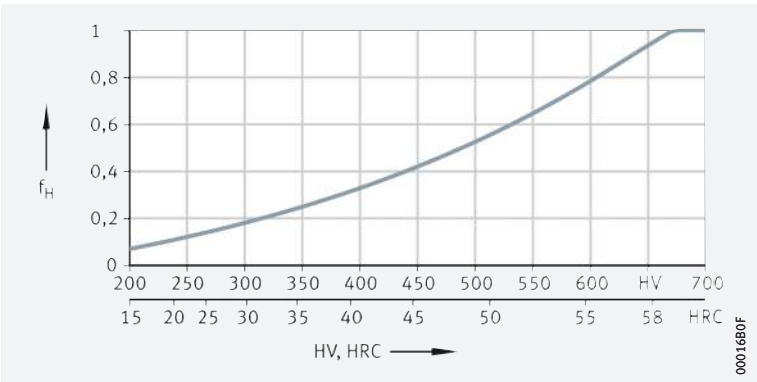


If the raceway fulfils the requirements for rolling bearing materials but the raceway hardness is less than 670 HV, the load on the bearing arrangement cannot be as high as the full load carrying capacity of the bearing. In order to determine the dynamic and static load carrying capacity of the bearing arrangement, the basic dynamic load rating C of the bearings must be multiplied by the reduction factor f_H (dynamic hardness factor) and the basic static load rating C_{0r} by the reduction factor f_{H0} (static hardness factor) ➤ 868 | ☐ 12 and ➤ 868 | ☐ 13.

☐ 12

Dynamic hardness factor
at reduced hardness
of raceways/rolling elements

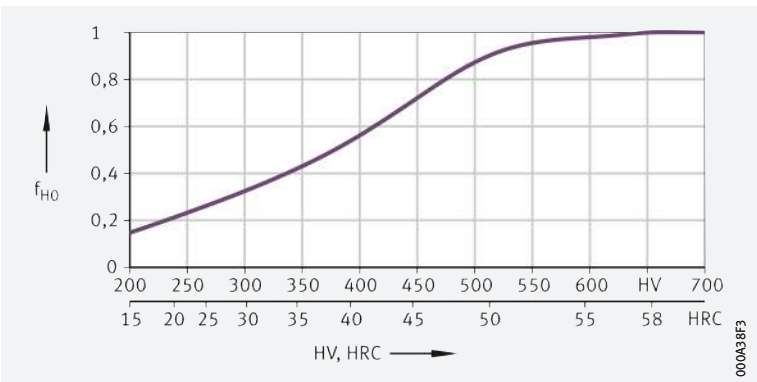
f_H = dynamic hardness factor
HV, HRC = surface hardness



☐ 13

Static hardness factor
at reduced hardness
of raceways/rolling elements

f_{H0} = static hardness factor
HV, HRC = surface hardness



Determining the case hardening depth

☞ Approximation value
for case hardening depth

An approximation value for determining the minimum hardness depth is given in ➤ 868 | ☐ 4. The reference value for the load present is the equivalent stress in accordance with the distortion energy hypothesis (DEH) as a function of the rolling element diameter D_w and the magnitude of the load.

☐ 4

Case hardening depth

$$CHD \geq 0,052 \cdot D_w$$

Legend

CHD	mm	Case hardening depth
D_w	mm	Rolling element diameter.



The local hardness must always be above the local requisite hardness, which can be calculated from the equivalent stress.

Determining the surface hardening depth



In these surface hardening methods, the load and contact geometry must be taken into consideration when determining the requisite hardening depth.

For calculation of the surface hardening depth SHD ➤ 869 | 5.

5
Surface hardening depth
Legend

$SHD \geq 140 \cdot D_w / R_{p0,2}$		
SHD	mm	Surface hardening depth
D_w	mm	Rolling element diameter
$R_{p0,2}$	N/mm ²	Yield point of base material.

Paired arrangement of needle roller and cage assemblies

The needle rollers must correspond to the same tolerance sort

If two needle roller and cage assemblies are arranged immediately adjacent to each other, it must be ensured that the bearings are loaded uniformly. In this case, the needle rollers used in these needle roller and cage assemblies must belong to the same diameter sort (tolerance sort). The dimensions of the needle rollers fitted in the bearings must be indicated on the specific bearing packaging.

1.17

Mounting and dismounting

Ensure that the bearings are not damaged during mounting

Needle roller and cage assemblies are either slid onto the shaft and then inserted in the housing or are mounted in the housing and the shaft is then inserted. Mounting is carried out without load and using a screwdriver type motion.

Rolling bearings must be handled with great care

Schaeffler Mounting Handbook

Rolling bearings are well-proven precision machine elements for the design of economical and reliable bearing arrangements, which offer high operational security. In order that these products can function correctly and achieve the envisaged operating life without detrimental effect, they must be handled with care.



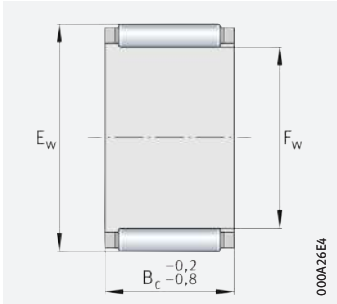
The Schaeffler Mounting Handbook MH 1 gives comprehensive information about the correct storage, mounting, dismounting and maintenance of rotary rolling bearings ➤ <https://www.schaeffler.de/std/1D53>. It also provides information which should be observed by the designer, in relation to the mounting, dismounting and maintenance of bearings, in the original design of the bearing position. This book is available from Schaeffler on request.





Needle roller and cage assemblies

Single row



Single row

F_w = 3 – 19 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{dr} min ⁻¹	m ≈ g	➤ 864 1.12 ➤ 864 1.13
3	5	7	1 540	1 290	152	50 000	78 000	0,3	K3×5×7-TV
	5	9	1 710	1 480	188	50 000	80 000	0,4	K3×5×9-TV
	6	7	1 430	970	109	47 000	75 000	0,4	K3×6×7-TV
4	7	10	2 330	1 840	236	42 500	59 000	0,7	K4×7×10-TV
	7	7	1 740	1 270	145	42 500	59 000	0,5	K4×7×7-TV
5	8	10	3 000	2 650	350	39 000	47 000	0,9	K5×8×10-TV
	8	8	2 350	1 920	237	39 000	48 000	0,7	K5×8×8-TV
6	10	13	3 800	3 100	395	35 500	40 000	1,9	K6×10×13-TV
	9	10	3 350	3 150	420	36 500	40 000	1,1	K6×9×10-TV
	9	8	2 600	2 280	285	36 500	41 000	0,8	K6×9×8-TV
7	10	10	3 650	3 600	485	34 500	35 000	1	K7×10×10-TV
	10	8	2 850	2 650	330	34 500	36 000	0,9	K7×10×8-TV
	9	7	1 680	1 700	203	35 500	40 500	0,6	K7×9×7-TV
8	11	10	3 950	4 100	560	32 500	31 000	1,2	K8×11×10-TV
	11	13	5 100	5 800	790	32 500	30 500	1,7	K8×11×13-TV
	11	8	3 100	3 000	375	32 500	32 000	1	K8×11×8-TV
	12	10	5 000	4 700	560	31 500	29 000	2	K8×12×10-TV
9	12	10	4 500	5 000	680	31 000	27 500	1,5	K9×12×10-TV
	12	13	5 900	7 100	970	31 000	27 000	2,1	K9×12×13-TV
10	13	10	4 750	5 500	750	29 500	24 900	1,6	K10×13×10-TV
	13	13	6 200	7 800	1 060	29 500	24 400	2,3	K10×13×13-TV
	13	16	7 100	9 300	1 310	29 500	24 600	2,9	K10×13×16-TV
	14	10	5 800	6 000	720	29 000	23 500	2,5	K10×14×10-TV
	14	13	7 500	8 400	1 020	29 000	23 000	4,6	K10×14×13-TV
	16	12	8 100	7 200	1 000	27 500	21 800	5,5	K10×16×12-TV
12	15	10	4 900	6 100	830	27 000	21 500	2,9	K12×15×10-TV
	15	13	6 400	8 500	1 170	27 000	21 100	2,3	K12×15×13-TV
	16	13	8 000	9 400	1 150	26 500	19 900	3,6	K12×16×13-TV
	17	13	9 600	10 400	1 330	26 500	18 800	4,9	K12×17×13-TV
	18	12	10 000	9 900	1 400	26 000	18 100	6	K12×18×12-TV

medias ➤ <https://www.schaeffler.de/std/1DF2>



Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation ► 864 1.12 ► 864 1.13
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{0r} min ⁻¹	m ≈ g	
14	18	10	7 100	8 500	1 060	25 000	17 300	4	K14×18×10
	18	13	8 200	10 100	1 320	25 000	17 700	6,5	K14×18×13
	18	15	9 500	12 300	1 540	25 000	17 400	5	K14×18×15-TV
	18	17	10 800	14 400	1 890	25 000	17 300	8	K14×18×17
	20	12	10 300	10 600	1 490	24 300	16 200	8,5	K14×20×12
15	18	17	8 000	12 100	1 730	24 600	17 700	4,6	K15×18×17-TV
	19	10	7 500	9 200	1 140	24 300	16 200	5	K15×19×10
	19	13	8 500	10 900	1 420	24 300	16 600	7	K15×19×13
	19	17	11 300	15 600	2 040	24 300	16 200	9,5	K15×19×17
	20	13	9 900	11 500	1 430	23 900	15 900	7	K15×20×13
	21	15	14 300	16 400	2 210	23 600	14 700	11	K15×21×15
16	21	21	19 400	24 300	3 300	23 600	14 400	17	K15×21×21
	20	10	7 800	9 900	1 230	23 600	15 200	5,5	K16×20×10
	20	13	8 900	11 800	1 530	23 600	15 600	7,5	K16×20×13
	20	17	11 700	16 800	2 190	23 600	15 200	10	K16×20×17
	22	12	11 500	12 500	1 780	22 900	14 300	10	K16×22×12
	22	16	14 800	17 500	2 390	22 900	14 100	12	K16×22×16
	22	20	18 300	22 800	3 050	22 900	14 000	17	K16×22×20
17	24	20	21 400	23 500	2 950	22 400	13 200	22	K16×24×20
	21	10	8 100	10 600	1 310	22 900	14 400	5,5	K17×21×10
	21	13	10 400	14 600	1 810	22 900	14 100	6,5	K17×21×13
	21	17	12 200	17 900	2 350	22 900	14 400	9,5	K17×21×17
18	22	10	8 400	11 300	1 400	22 400	13 600	6	K18×22×10
	22	13	9 200	12 700	1 650	22 400	14 200	8	K18×22×13
	22	17	12 100	18 000	2 360	22 400	13 900	11	K18×22×17
	24	12	12 800	14 900	2 120	21 800	12 700	12	K18×24×12
	24	13	13 100	15 300	1 990	21 800	12 900	13	K18×24×13
	24	20	20 200	27 000	3 550	21 800	12 400	18	K18×24×20
	25	22	23 100	29 000	3 750	21 600	12 200	23	K18×25×22
19	23	13	9 500	13 500	1 750	21 800	13 500	8	K19×23×13
	23	17	12 500	19 200	2 500	21 800	13 200	11	K19×23×17

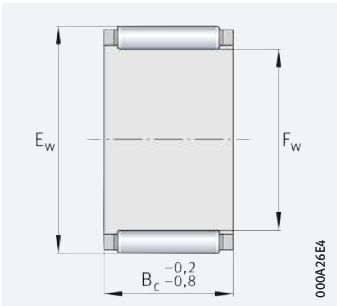
medias ► <https://www.schaeffler.de/std/1DF3>



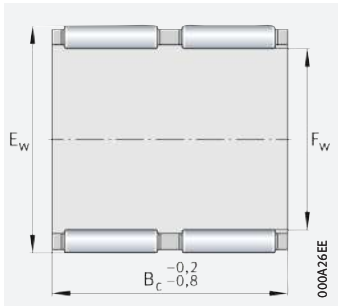


Needle roller and cage assemblies

Single row
Double row



Single row



Double row (K...ZW)

F_w = 20 – 30 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{dr} min ⁻¹	m ≈ g	➤ 864 1.12 ➤ 864 1.13
20	24	10	8 900	12 600	1 570	21 300	12 400	6,5	K20×24×10
	24	13	9 800	14 300	1 860	21 300	12 800	9	K20×24×13
	24	17	12 900	20 400	2 650	21 300	12 500	12	K20×24×17
	26	12	13 400	16 200	2 310	20 900	11 700	11	K20×26×12
	26	13	14 400	17 900	2 330	20 900	11 600	12	K20×26×13
	26	17	19 200	26 000	3 300	20 900	11 200	16	K20×26×17
	26	20	21 100	29 000	3 900	20 900	11 400	19	K20×26×20
	28	16	19 800	22 400	3 000	20 400	11 100	20	K20×28×16
	28	20	23 900	28 500	3 600	20 400	11 100	27	K20×28×20
	28	25	30 500	39 000	5 300	20 400	10 800	32	K20×28×25
21	30	30	35 500	41 500	5 500	19 600	10 800	49	K20×30×30
	25	13	10 100	15 100	1 970	20 900	12 300	9	K21×25×13
22	26	10	9 100	13 400	1 670	20 400	11 500	7,5	K22×26×10
	26	13	10 400	15 900	2 080	20 400	11 800	9,5	K22×26×13
	26	17	13 700	22 700	3 000	20 400	11 500	12	K22×26×17
	28	17	19 400	27 000	3 450	19 600	10 500	18	K22×28×17
	29	16	20 000	25 500	3 350	19 200	10 300	16	K22×29×16
	30	15	20 100	23 400	3 050	18 800	10 200	18	K22×30×15-TV
	32	24	34 000	40 000	4 900	18 100	9 700	43	K22×32×24
23	35	16	24 500	23 900	2 950	16 900	9 500	29	K23×35×16-TV
24	28	10	9 600	14 800	1 840	18 800	10 600	8,5	K24×28×10
	28	13	11 000	17 600	2 290	18 800	10 800	10	K24×28×13
	28	17	14 500	25 000	3 300	18 800	10 600	13	K24×28×17
	30	17	19 500	27 500	3 500	18 100	10 000	19	K24×30×17
	30	31	27 500	43 500	5 800	18 100	10 400	32	K24×30×31-ZW

medias ➤ <https://www.schaeffler.de/std/1DF4>



Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{gr} min ⁻¹	m ≈ g	► 864 1.12 ► 864 1.13
25	29	10	9 900	15 400	1 930	18 100	10 200	8,5	K25×29×10
	29	13	11 300	18 400	2 400	18 100	10 400	11	K25×29×13
	29	17	14 900	26 000	3 450	18 100	10 200	14	K25×29×17
	30	13	14 600	21 800	2 800	17 800	9 800	12	K25×30×13
	30	17	18 700	30 000	3 850	17 800	9 600	16	K25×30×17
	30	20	21 700	36 500	4 850	17 800	9 500	18	K25×30×20
	30	26	21 400	35 500	4 500	17 800	10 400	19	K25×30×26-ZW
	31	17	19 600	28 500	3 600	17 500	9 600	19	K25×31×17
	31	21	24 700	38 000	5 100	17 500	9 400	20	K25×31×21
	32	16	20 800	27 500	3 650	17 200	9 400	21	K25×32×16
	33	20	28 500	38 000	4 850	16 900	9 000	33	K25×33×20
	33	24	34 000	47 000	6 300	16 900	8 900	39	K25×33×24
	35	30	47 000	62 000	8 300	16 300	8 500	65	K25×35×30
26	30	13	11 600	19 200	2 500	17 500	10 100	11	K26×30×13
	30	17	15 200	27 500	3 600	17 500	9 800	15	K26×30×17
	30	22	15 700	28 500	3 550	17 500	10 400	12	K26×30×22-ZW
28	33	13	15 300	24 200	3 100	16 100	8 900	13	K28×33×13
	33	17	19 700	33 500	4 250	16 100	8 700	17	K28×33×17
	34	17	21 800	33 500	4 300	15 800	8 600	24	K28×34×17
	35	16	21 500	29 500	3 950	15 600	8 700	24	K28×35×16
	35	18	24 000	34 000	4 700	15 600	8 600	27	K28×35×18
	40	25	45 500	55 000	6 600	14 400	7 700	70	K28×40×25
30	34	13	12 300	21 700	2 850	15 300	8 900	14	K30×34×13
	35	13	15 600	25 500	3 250	15 100	8 400	14	K30×35×13
	35	17	19 600	34 000	4 300	15 100	8 300	19	K30×35×17
	35	27	30 500	59 000	8 500	15 100	8 100	30	K30×35×27
	37	16	23 100	33 500	4 450	14 600	8 000	27	K30×37×16
	37	18	26 000	38 500	5 300	14 600	8 000	30	K30×37×18
	40	18	32 000	40 000	5 000	14 000	7 600	48	K30×40×18
	40	30	49 000	69 000	9 200	14 000	7 500	73	K30×40×30

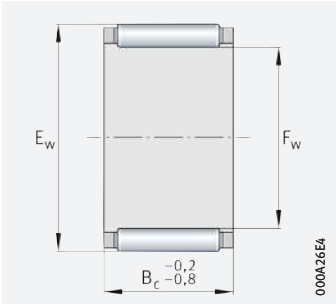
medias ► <https://www.schaeffler.de/std/1DF5>



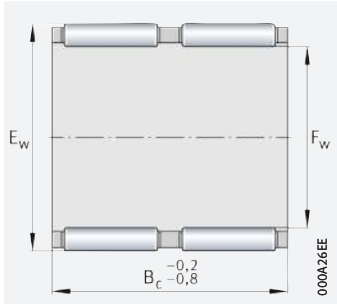


Needle roller and cage assemblies

Single row
Double row



Single row



Double row (K...ZW)

F_w = 32 – 47 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{dr} min ⁻¹	m ≈ g	
32	37	13	15 500	25 500	3 300	14 200	8 100	18	K32×37×13
	37	17	19 900	35 500	4 500	14 200	7 900	19	K32×37×17
	37	27	30 000	60 000	8 500	14 200	7 800	30	K32×37×27
	38	20	26 500	45 000	6 000	14 000	7 700	30	K32×38×20
	39	16	23 800	35 500	4 700	13 800	7 600	37	K32×39×16
	39	18	26 500	41 000	5 600	13 800	7 500	31	K32×39×18
	40	25	37 500	58 000	7 900	13 600	7 400	49	K32×40×25
	40	42	50 000	84 000	10 500	13 600	7 800	77	K32×40×42-ZW-TV
35	46	32	66 000	84 000	11 100	12 600	6 700	119	K32×46×32
	40	13	16 200	28 000	3 600	13 100	7 500	19	K35×40×13
	40	17	20 800	38 500	4 900	13 100	7 400	21	K35×40×17
	40	25	29 500	60 000	8 400	13 100	7 200	31	K35×40×25
	40	27	25 000	48 500	6 700	13 100	7 900	39	K35×40×27-TV
	42	16	24 400	37 500	5 000	12 700	7 100	34	K35×42×16
	42	18	27 500	43 000	6 000	12 700	7 100	34	K35×42×18
	42	20	30 000	49 000	6 200	12 700	7 000	37	K35×42×20
	42	30	39 000	68 000	9 400	12 700	7 200	67	K35×42×30
	45	20	37 000	50 000	6 500	12 300	6 800	56	K35×45×20
37	45	30	53 000	79 000	10 500	12 300	6 700	80	K35×45×30
	42	17	22 400	43 000	5 500	12 400	6 900	22	K37×42×17
38	43	17	20 500	38 500	4 850	12 100	7 000	29	K38×43×17
	43	27	31 500	68 000	9 600	12 100	6 800	43	K38×43×27
	46	20	35 500	57 000	7 200	11 700	6 300	47	K38×46×20
	46	32	55 000	99 000	14 200	11 700	6 200	76	K38×46×32
39	44	26	27 500	56 000	7 100	11 800	7 000	45	K39×44×26-ZW

medias ► <https://www.schaeffler.de/std/1DF6>



Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r	stat. C _{0r}	C _{ur}	n _G	n _{0r}	m	
			N	N	N	min ⁻¹	min ⁻¹	≈ g	
40	45	13	17 600	32 500	4 200	11 500	6 600	22	K40×45×13
	45	17	21 400	41 500	5 200	11 500	6 700	31	K40×45×17
	45	27	33 000	73 000	10 300	11 500	6 500	46	K40×45×27
	47	18	29 500	50 000	6 900	11 300	6 300	39	K40×47×18
	47	20	32 500	57 000	7 200	11 300	6 200	42	K40×47×20
	48	20	36 000	59 000	7 500	11 100	6 100	49	K40×48×20
42	47	13	17 800	33 500	4 350	11 000	6 400	18	K42×47×13
	47	17	21 700	43 000	5 400	11 000	6 400	32	K42×47×17
	47	30	33 500	76 000	10 000	11 000	6 400	54	K42×47×30-ZW
	50	20	35 000	57 000	7 300	10 700	6 000	53	K42×50×20
43	48	17	21 600	43 000	5 400	10 800	6 300	30	K43×48×17
	48	27	33 500	75 000	10 700	10 800	6 200	50	K43×48×27
45	50	17	22 500	46 000	5 800	10 300	6 100	34	K45×50×17
	50	27	34 500	80 000	11 400	10 300	5 900	51	K45×50×27
	52	18	31 500	57 000	7 900	10 100	5 700	42	K45×52×18
	53	20	39 000	67 000	8 700	10 000	5 500	55	K45×53×20
	53	21	38 500	67 000	8 600	10 000	5 600	60	K45×53×21
	53	28	52 000	98 000	13 700	10 000	5 400	81	K45×53×28
	59	18	44 500	54 000	6 900	9 400	5 400	72	K45×59×18-TV
	59	32	73 000	103 000	13 800	9 400	5 300	148	K45×59×32
47	52	17	23 300	49 000	6 100	9 900	5 800	35	K47×52×17
	52	27	35 000	83 000	11 800	9 900	5 700	51	K47×52×27

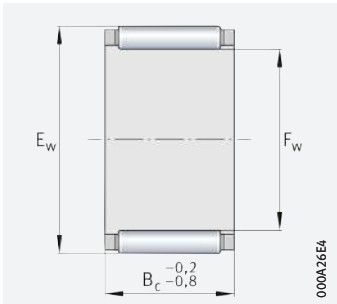
medias ► <https://www.schaeffler.de/std/1DF7>



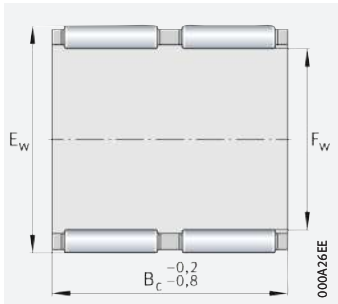


Needle roller and cage assemblies

Single row
Double row



Single row



Double row (K...ZW)

F_w = 50 – 95 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{0r} min ⁻¹	m ≈ g	➤ 864 1.12 ➤ 864 1.13
50	55	13,5	18 200	36 500	4 600	9 300	5 700	30	K50×55×13,5
	55	17	26 000	57 000	7 300	9 300	5 300	35	K50×55×17
	55	20	26 500	60 000	7 800	9 300	5 500	43	K50×55×20
	55	30	39 000	97 000	13 900	9 300	5 400	65	K50×55×30
	57	18	33 500	63 000	8 800	9 200	5 200	47	K50×57×18
	58	20	35 500	62 000	8 800	9 100	5 400	75	K50×58×20
	58	25	44 000	81 000	10 800	9 100	5 300	90	K50×58×25
52	57	12	18 000	36 500	4 600	9 000	5 400	24	K52×57×12
55	60	20	28 500	66 000	8 600	8 500	5 100	40	K55×60×20
	60	27	38 000	97 000	13 600	8 500	4 950	60	K55×60×27
	60	30	41 000	108 000	15 400	8 500	4 950	71	K55×60×30
	62	18	35 500	70 000	9 800	8 400	4 750	52	K55×62×18
	63	20	40 000	74 000	9 500	8 300	4 800	67	K55×63×20
	63	25	50 000	100 000	13 700	8 300	4 700	80	K55×63×25
	63	32	62 000	130 000	18 600	8 300	4 650	102	K55×63×32
58	65	18	35 000	70 000	9 800	8 000	4 650	52	K58×65×18
	65	36	49 000	107 000	14 600	8 000	5 100	127	K58×65×36-ZW
60	65	20	29 500	72 000	9 300	7 800	4 750	52	K60×65×20
	65	30	42 500	116 000	16 600	7 800	4 650	77	K60×65×30
	66	33	46 000	112 000	15 100	7 800	4 800	104	K60×66×33-ZW
	66	40	58 000	151 000	19 900	7 800	4 650	116	K60×66×40-ZW
	68	20	43 500	85 000	11 000	7 700	4 400	71	K60×68×20
	68	23	49 500	101 000	13 500	7 700	4 350	94	K60×68×23
	68	25	53 000	111 000	15 200	7 700	4 350	89	K60×68×25
	68	30	44 500	88 000	11 300	7 700	4 950	129	K60×68×30-ZW
	75	42	118 000	199 000	27 000	7 300	4 050	240	K60×75×42
62	70	40	66 000	146 000	20 500	7 400	4 550	174	K62×70×40-ZW
64	70	16	28 000	60 000	8 100	7 300	4 500	53	K64×70×16

medias ➤ <https://www.schaeffler.de/std/1DF8>



Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F _w	E _w	B _c	dyn. C _r N	stat. C _{0r} N	C _{ur} N	n _G min ⁻¹	n _{gr} min ⁻¹	m ≈ g	► 864 1.12 ► 864 1.13
65	70	20	30 500	77 000	10 000	7 300	4 450	56	K65×70×20
	70	30	44 000	124 000	17 800	7 300	4 350	83	K65×70×30
	73	23	46 000	94 000	12 200	7 100	4 300	108	K65×73×23
	73	30	57 000	123 000	17 100	7 100	4 300	141	K65×73×30
68	74	20	35 500	84 000	11 000	6 900	4 200	71	K68×74×20
	74	30	46 500	118 000	16 900	6 900	4 300	100	K68×74×30
	74	35	48 500	125 000	17 200	6 900	4 450	120	K68×74×35-ZW
70	76	20	36 000	86 000	11 300	6 700	4 100	71	K70×76×20
	76	30	52 000	139 000	20 100	6 700	4 000	110	K70×76×30
	78	30	60 000	135 000	18 800	6 600	4 000	148	K70×78×30
72	80	20	41 500	85 000	11 900	6 400	4 000	98	K72×80×20
73	79	20	37 000	90 000	11 800	6 400	4 000	75	K73×79×20
75	81	20	37 500	94 000	12 300	6 300	3 850	79	K75×81×20
	81	30	52 000	143 000	20 400	6 300	3 850	114	K75×81×30
	83	23	50 000	109 000	14 200	6 200	3 800	124	K75×83×23
	83	30	62 000	143 000	20 000	6 200	3 800	147	K75×83×30
	83	35	63 000	147 000	19 900	6 200	3 950	182	K75×83×35-ZW
	83	40	73 000	177 000	25 000	6 200	3 900	211	K75×83×40-ZW
80	86	20	38 500	98 000	12 900	5 900	3 700	60	K80×86×20
	88	30	71 000	176 000	25 000	5 800	3 400	138	K80×88×30
	88	40	76 000	192 000	27 000	5 800	3 700	227	K80×88×40-ZW
	88	46	88 000	231 000	30 000	5 800	3 650	260	K80×88×46-ZW
85	92	20	44 500	108 000	15 100	5 500	3 450	102	K85×92×20
90	97	20	45 000	113 000	15 800	5 200	3 300	109	K90×97×20
	98	27	61 000	150 000	20 300	5 200	3 300	150	K90×98×27
	98	30	68 000	172 000	24 000	5 200	3 300	172	K90×98×30
95	103	30	69 000	180 000	25 000	4 950	3 150	165	K95×103×30
	103	40	83 000	228 000	32 500	4 950	3 200	266	K95×103×40-ZW

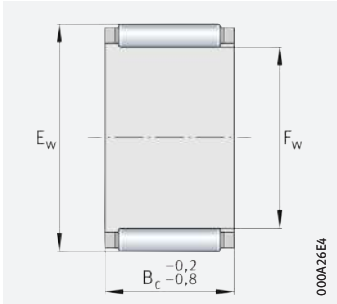
medias ► <https://www.schaeffler.de/std/1DF9>





Needle roller and cage assemblies

Single row



Single row

$F_w = 100 - 265 \text{ mm}$

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
F_w	E_w	B_c	dyn. C_r N	stat. C_{0r} N	C_{ur} N	n_G min^{-1}	n_{dr} min^{-1}	m $\approx \text{g}$	
100	107	21	48 000	127 000	17 600	4 750	3 100	120	K100×107×21
	108	27	57 000	143 000	18 900	4 700	3 200	185	K100×108×27
	108	30	71 000	188 000	26 000	4 700	3 050	180	K100×108×30
105	112	21	47 500	127 000	17 400	4 500	3 000	129	K105×112×21
110	117	24	56 000	158 000	19 800	4 300	2 850	172	K110×117×24
	118	30	78 000	219 000	29 500	4 300	2 750	217	K110×118×30
115	123	27	63 000	170 000	21 600	4 100	2 850	200	K115×123×27
120	127	24	59 000	174 000	21 400	3 950	2 650	165	K120×127×24
125	133	35	86 000	260 000	34 500	3 800	2 600	275	K125×133×35
130	137	24	61 000	186 000	22 300	3 650	2 500	170	K130×137×24
135	143	35	91 000	290 000	37 500	3 550	2 390	300	K135×143×35
145	153	26	74 000	225 000	27 000	3 300	2 280	262	K145×153×26
150	160	46	147 000	470 000	60 000	3 150	2 100	570	K150×160×46
155	163	26	75 000	236 000	28 000	3 100	2 180	265	K155×163×26
160	170	46	152 000	510 000	63 000	2 950	1 970	550	K160×170×46
165	173	26	81 000	265 000	30 500	2 900	2 030	320	K165×173×26
175	183	32	99 000	350 000	41 500	2 750	1 930	400	K175×183×32
185	195	37	128 000	425 000	48 500	2 600	1 840	607	K185×195×37
195	205	37	133 000	450 000	51 000	2 450	1 760	620	K195×205×37
210	220	42	154 000	560 000	63 000	2 280	1 590	740	K210×220×42
220	230	42	158 000	590 000	66 000	2 180	1 510	790	K220×230×42
240	250	42	164 000	630 000	69 000	2 000	1 390	850	K240×250×42
265	280	50	255 000	860 000	91 000	1 800	1 160	1 810	K265×280×50

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