FAG

Toroidal Roller Bearings TORB

Longer rating life and operating life – higher technical and economic performance

SCHAEFFLER

Foreword

Schaeffler Technologies

Schaeffler Technologies with its brands INA and FAG is a leading worldwide supplier of rolling bearings, spherical plain bearings, plain bearings, linear products, accessories specific to bearings and comprehensive maintenance products and services.
It has approximately 40 000 catalogue products manufactured as standard, providing an extremely wide portfolio that gives secure coverage of applications from all 60 industrial market sectors.

The central factors responsible for this success are our outstanding strength in innovation, our global focus on local customer proximity, highly developed manufacturing methods, extremely high quality standards in all processes and our ability to transform specific customer requirements quickly and accurately into cost-effective solutions. Against this background of expertise, knowledge and experience together with our wide range of catalogue items, we see ourselves as a high performance, customer focussed partner.

TORB – what is it?

The toroidal roller bearing TORB is a new type of rolling bearing from Schaeffler. It is a single row rolling bearing with long, slightly crowned rollers. When used as a non-locating bearing, it combines the self-alignment function of a spherical roller bearing with the axial displacement facility of a cylindrical roller bearing or needle roller bearing.

Contents

Toroidal roller bearings

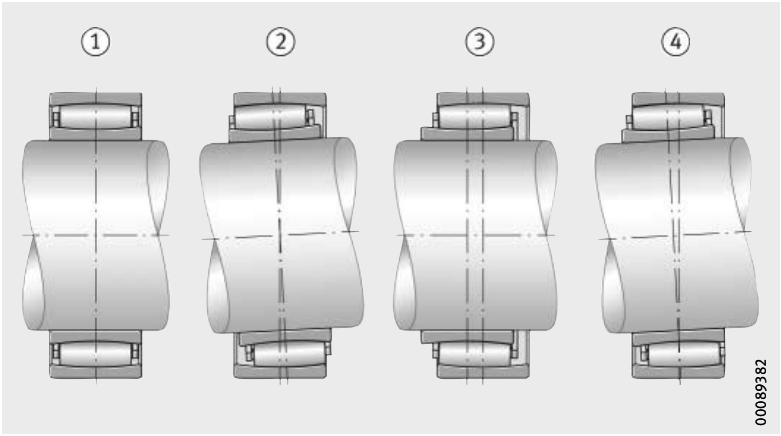
Features

FAG toroidal roller bearings are single row bearings with long, crowned rollers. The concave raceways in the inner ring and outer ring are concentric relative to the centre of the bearing. The raceway profiles are matched to each other and ensure optimum distribution of stresses in the bearing as well as low operating friction.

The rollers are self-guiding. They will always automatically adopt the position at which the load is distributed over the length of the roller. This is also the case if the rings are displaced or skewed relative to each other, *Figure 1*.

The toroidal roller bearing combines the angular adjustment facility of a spherical roller bearing with the unconstrained axial displacement facililty of a cylindrical roller bearing. It offers a very high radial load carrying capacity within a small design envelope.

Toroidal roller bearings offer an ideal and operationally reliable solution to the problem of achieving a locating/non-locating bearing. Since axial displacement is compensated within the toroidal roller bearing, the constraining forces occurring are very slight and can be disregarded.



① Initial position
② Inner ring with tilting
③ Inner ring with axial displacement
④ Inner ring with displacement and tilting

Figure 1
Toroidal roller bearing
(tilting and axial displacement)

A particularly high load carrying capacity is available in the full complement design, indicated by the suffix V, *Figure 2*.
Full complement toroidal roller bearings are intended for applications such as continuous casting lines.

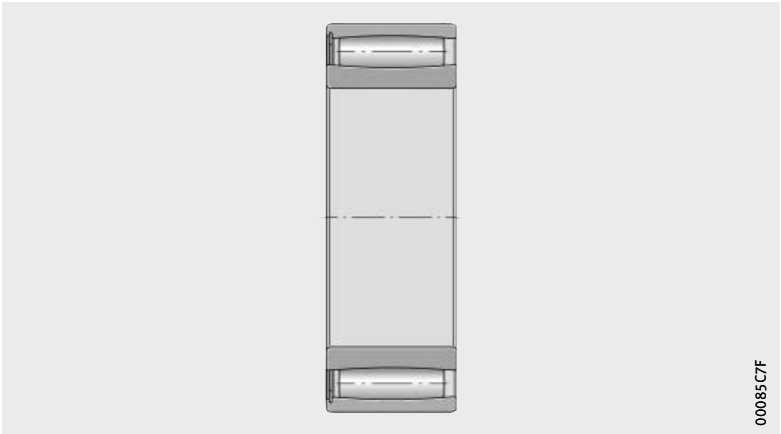


Figure 2
Full complement
toroidal roller bearing

X-life

X-life is the premium brand that identifies particularly high performance products under the FAG and INA brands.
They are characterised by longer rating life and operating life, due to higher basic dynamic load ratings compared to the previous standard, *Figure 3*.

This higher performance results from the use of state of the art manufacturing techniques and improved internal constructions. They lead to better and more uniform surfaces and contact areas and thus optimised load distribution in the bearing.

This opens up expanded design possibilities:

- Under the same load and with an unchanged design envelope, X-life bearings have a longer rating life and maintenance intervals can be extended.
- Conversely, an X-life bearing in the same design envelope and with the same rating life can support higher loads.
- Where the rating life and load remain unchanged, X-life bearings allow higher performance density, facilitating optimisation of the design envelope and reductions in mass.

As a result, the X-life bearing makes a significant contribution to improved overall cost-efficiency under the philosophy of Total Cost of Ownership (TCO).

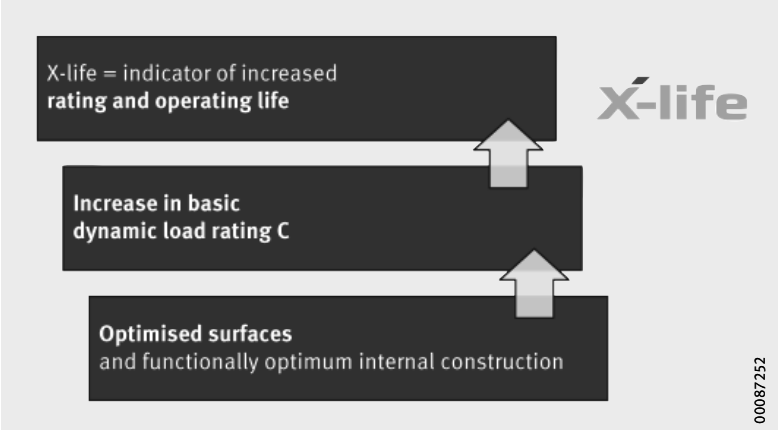


Figure 3
Key characteristics of X-life

Toroidal roller bearings

The ideal non-locating bearing concept

Where a shaft is liable to temperature-induced elongation and misalignment defects, the non-locating bearing is a particularly important concept. In this case, toroidal roller bearings have proved ideal as non-locating bearings, *Figure 4*.

In comparison with normal non-locating bearing arrangements, they offer significant advantages:

- Substantial changes in shaft length are compensated without constraint between the raceways and the rolling elements within the bearing. The design work involved in other solutions is unnecessary.
- Even more considerable axial displacements have no effect on the locating bearing.
- There is no axial distortion of the bearing system.

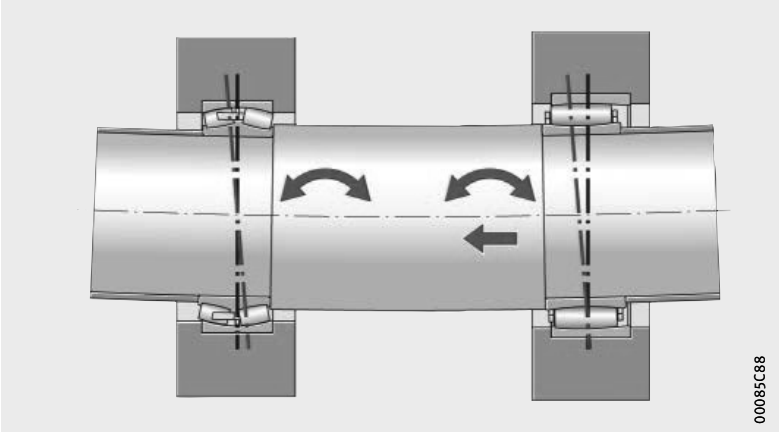


Figure 4
The ideal non-locating bearing concept

Principal areas of application

The principal areas of application of toroidal roller bearings are:

- steelworks and rolling mills
- conveying equipment and belt installations
- paper machinery
- continuous flow machines
- crushers
- gearboxes
- textile machinery
- machinery for food processing
- agricultural equipment.

Requirements

The requirements placed on the bearings are:

- constraint-free non-locating bearing function
- high load carrying capacity
- high operational reliability
- long operating life
- low maintenance outlay
- low operating costs
- compact construction
- high performance capability.

Operating temperature

Toroidal roller bearings are dimensionally stable up to +200 °C. Bearings with metal cages can be used at operating temperatures from –30 °C to +200 °C.

Lubrication

Open toroidal roller bearings can be lubricated with oil or grease. Lubricant is introduced from one side. Lubricant exits on the opposing side.

Cages

Toroidal roller bearings are essentially available in two designs:

- full complement
- bearing with cage.

Full complement bearings have a higher load carrying capacity than the variant with a cage.

Depending on the series and bearing size, toroidal roller bearings are supplied as standard with the following cage designs:

- roller-guided sheet steel cage, single-piece, no suffix
- roller-guided brass window cage, suffix M
- brass window cage, guided on inner ring, suffix M1B.

Suffix

Suffixes for available designs, see table.

Available designs

Suffix	Description
XL	X-life quality
K	Tapered bore, bore ratio 1:12
K30	Tapered bore, bore ratio 1:30
C2	Internal clearance smaller than Group N
C3	Internal clearance larger than Group N
C4	Internal clearance larger than Group 3
C5	Internal clearance larger than Group 4
V	Full complement
M	Brass window cage, guided by rollers
M1B	Brass window cage, guided on inner ring
W209B	Inner ring made from case hardening steel

Toroidal roller bearings

Product range

The range of FAG toroidal roller bearings comprises eight series, *Figure 5*.

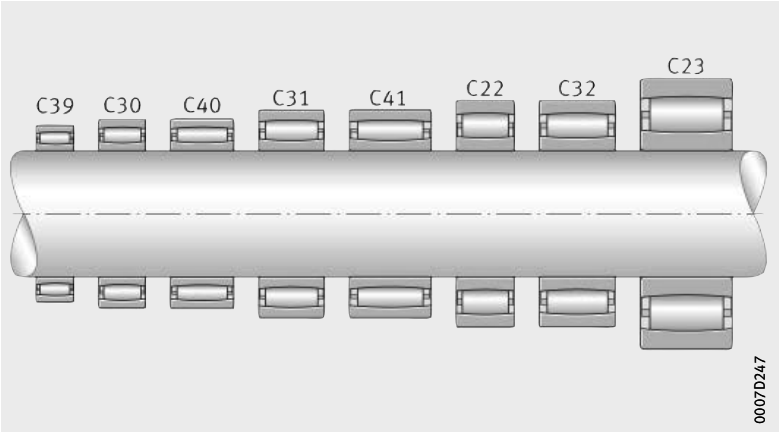


Figure 5
Product range

Interchangeability

Full interchangeability of the bearings is assured, since toroidal roller bearings are manufactured as standard in the same ISO dimension series and sizes as spherical roller bearings.

Products for mounting, maintenance and monitoring

In order to ensure that the high performance capability of FAG toroidal roller bearings can be exploited to the full, particular attention must be paid to their mounting and dismounting, lubrication, sealing and maintenance.

The methods used in mounting and dismounting are comprehensively described in publication MH 1, Mounting of Rolling Bearings. In those cases where a production stoppage can incur heavy costs, monitoring of rolling bearings is both advisable and cost-effective. An overview of suitable tools, measuring devices and diagnostic equipment can be found in Catalogue IS 1, Mounting and Maintenance of Rolling Bearings.

Special tool extractor PULLER-SPECIAL-E

The extractor PULLER-SPECIAL-E is a tool for the dismounting of spherical roller bearings and toroidal roller bearings.

The dismounting tool has specially produced fingers that grip the end faces of the rollers from behind. The extractor then presses on the shaft by means of a hydraulic cylinder and pulls the bearing out.

Bearing housings

Through the combination of a toroidal roller bearing and FAG bearing housing, it is possible to create non-locating bearing arrangement units that are interchangeable and operationally reliable. As a result, economical and maintenance-friendly designs can be achieved, *Figure 6*.

Figure 6
Bearing housing
with toroidal roller bearing

Design and safety guidelines

Permissible skewing

Toroidal roller bearings can be tilted by an angle of up to 0,5° between the centre axes of the inner ring and outer ring without impairment of the function and rating life. In this way, the toroidal roller bearing can compensate a slight geometrical deviation of the housing bore or a shaft that is not precisely aligned without difficulty.

Depending on the series and size, skewing of more than 0,5° is possible but may be associated with a reduction in the rating life. In the case of such applications, please contact our technical advisory service in order to achieve an optimum design of the bearing arrangement.

Axial displacement facility

Toroidal roller bearings can accommodate axial offset and thus compensate thermal expansion or deviations from the required bearing position. The maximum displacement distances s_1 and s_2, which are specific to the product type, apply only where a sufficiently large operating clearance is present and to untilted bearing rings. Axial displacement and tilting changes the position of the rolling element in the bearing, which affects the operating clearance.

During the design process, it must always be checked whether the operating clearance required will be present if there is:

- axial displacement
- tilting
- axial displacement and tilting.

In the case of full complement bearings, the displacement distance s_2 is restricted on one side by the retaining ring. This ensures that the crowned roller does not come into contact with the retaining ring.

In order to ensure that the axial displacement distance is available, it is necessary that the free space on both sides of the bearing is observed, see page 21.

In order to ensure the function of the toroidal roller bearings, two different situations must be checked. On the one hand, it must be checked whether the axial displacement distance in combination with the tilting is still within the permitted displacement distance s_1 or s_2 respectively. Since axial displacement and tilting affect the bearing clearance, it must also be checked whether sufficient operating clearance will be present in the application.

The resulting bearing clearance can be determined using the following equation:

$$s_{res} = s_{ini} - k_{\delta} \cdot \left(\delta_{ax} + k_{\varphi} \cdot \varphi\right)^2$$

s_{res} µm
Resulting bearing clearance after tilting and axial displacement

s_{ini} µm
Radial internal clearance after mounting

k_{δ} –
Operating clearance factor, see dimension table

δ_{ax} mm
Axial displacement from central position

k_{φ} –
Tilting factor, see dimension table

φ °
Tilting between inner ring and outer ring (misalignment ± shaft deflection).

Other influences such as differences in temperature between the inner ring and outer ring must also be taken into consideration.

The individual influences are described in detail below.

Geometrical restriction of the axial displacement facility

Tilting causes axial displacement of the rollers from the central position. This means that the axial displacement facility of the bearing rings relative to each other is reduced by s_{φ}.

This reduction in the axial displacement facility due to tilting can be calculated as follows:

$$s_{\varphi} = k_{\varphi} \cdot \varphi$$

s_{φ} mm
Reduction in axial displacement facility as a result of tilting

k_{φ} –
Tilting factor, see dimension table

φ °
Tilting between inner ring and outer ring (misalignment ± shaft deflection).

When tilting occurs at the same time, the maximum possible axial displacement facility is calculated as follows:

$$s_{red} = s_1 - s_{\varphi}$$

In the case of full complement bearings, there is an additional effect as follows:

$$s_{red} = s_2 - s_{\varphi}$$

s_{red} mm
Maximum axial displacement facility under tilting

s_1 mm
Maximum axial displacement facility from dimension table, in the case of full complement bearings this is in the opposing direction to the retaining ring

s_{φ} mm
Reduction in axial displacement facility as a result of tilting

s_2 mm
Maximum axial displacement facility from dimension table, in the case of full complement bearings this is in the direction of the retaining ring.

Restriction due to reduction in radial bearing clearance

The bearing clearance is reduced in the following cases:

- axial displacement
- tilting of the bearing from the central position
- axial displacement and tilting of the bearing from the central position.

Depending on the necessary operating clearance, it must be checked whether the required axial displacement is possible under the tilting present.

The reduction in operating clearance is calculated as follows:

$$\Delta s = k_{\delta} \cdot \left(\delta_{ax} + k_{\varphi} \cdot \varphi\right)^2$$

Δs μm
Reduction in radial bearing clearance

k_{δ} –
Operating clearance factor, see dimension table

δ_{ax} mm
Axial displacement

k_{φ} –
Tilting factor, see dimension table

φ °
Tilting between inner ring and outer ring (misalignment ± shaft deflection).

Example 1

The toroidal roller bearing C3144-XL-K-C4 with a tapered bore is supplied with an internal clearance of 390 µm, while the operating clearance in the central position is only 240 µm due to mounting.

Application:
In the dryer roll, the misalignment is 0,2° and the shaft also undergoes thermal elongation of 6,3 mm.
Is this displacement permissible in addition to the tilting?
What is the change in the operating clearance?

k_φ = 13,67, see dimension table
φ = 0,2
s_1 = 22,3, see dimension table

$$s_\varphi = k_\varphi \cdot \varphi$$

$$s_\varphi = 13{,}67 \cdot 0{,}2 \approx 2{,}73 \text{ mm}$$

s_φ mm
Reduction in axial displacement facility as a result of tilting
k_φ –
Tilting factor, see dimension table
φ °
Tilting between inner ring and outer ring (misalignment ± shaft deflection).

$$s_{max} = s_1 - s_\varphi$$

$$s_{max} = 22{,}30 \text{ mm} - 2{,}73 \text{ mm} = 19{,}57 \text{ mm}$$

The axial displacement by 6,3 mm is in the permissible range of 19,57 mm in combination with tilting by 0,2°. The application must now be checked in relation to the reduction in operating clearance.

k_δ = 0,791, see dimension table
δ_{ax} = 6,30 mm

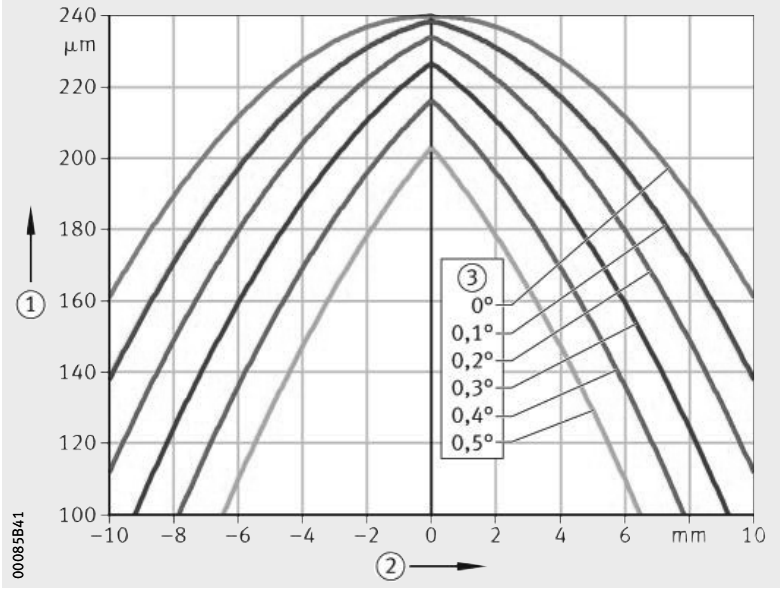
$$s_{res} = s_{ini} - k_\delta \cdot \left(\delta_{ax} + k_\varphi \cdot \varphi\right)^2$$

$$s_{res} = 240\ \mu\text{m} - 0{,}791 \cdot \left(6{,}3 + 2{,}73\right)^2 \approx 175\ \mu\text{m}$$

The resulting bearing clearance after tilting and axial displacement is 175 µm.

The influence of the difference in temperature between the inner ring and outer ring must also be taken into consideration.

The axial displacement facility for the bearing C3144 is shown as an example, *Figure 7*, page 14. The actual internal clearance as a function of axial displacement is shown in relation to the bearing width.



① Operating clearance in µm
② Axial displacement in mm
③ Tilting in °

Figure 7
Resulting operating clearance of the bearing C3144-XL-K-C4 as a function of tilting and axial displacement

Equivalent dynamic and static bearing load

Toroidal roller bearings can only support radial loads. Therefore:

- $P = P_0 = F_r$.

Permissible dynamic bearing load

The permissible dynamic bearing load is always as follows:

- $P \leqq 0{,}33 \cdot C_r$.

In the case of toroidal roller bearings up to a bore diameter d = 200 mm, the dynamic load is as follows:

- $P \leqq 0{,}18 \cdot C_{0r}$.

In applications with very high dynamic loads, the rating life calculation must be carried out in greater detail. In these cases, please contact the technical advisory service of Schaeffler.

Minimum load

In order to ensure operation without slippage, the bearings must be subjected to a minimum radial load $F_{r\,min}$. This applies in particular to high speed bearings since, if the radial load is insufficient or not present, damaging sliding motion may occur between the rolling elements and raceways.

The requisite minimum radial load $F_{r\,min}$ is defined as:

$$F_{r\,min} = 0{,}0135 \cdot C_0$$

$F_{r\,min}$ kN
Minimum radial load

C_0 kN
Basic static load rating.

If oil lubrication is used, the requisite minimum load is reduced as a function of the bearing type and speed.

In order to calculate this reduction, the ancillary value k_r must first be calculated as follows:

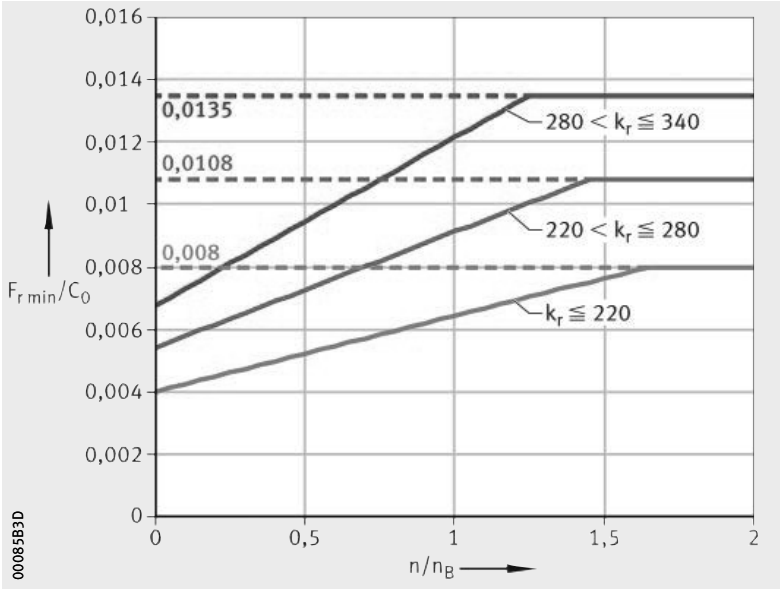
$$k_r = k_\delta \cdot d_M$$

k_r –
Ancillary value

k_δ –
Operating clearance factor, see dimension table

d_M mm
Mean bearing diameter (d+D)/2.

With the aid of this ancillary value and the ratio n/n_B, the requisite minimum load can be read off relative to the basic static load rating C_0, *Figure 8*.



$F_{r\,min}$ = minimum radial load
C_0 = basic static load rating
n = speed
n_B = reference speed
k_r = ancillary value

Figure 8
Minimum load with oil lubrication

Alternatively, the requisite minimum load can also be calculated, see table.

As a function of k_r, the factors for calculation of the minimum load should be selected as follows:

Factors for calculation of minimum load

Ancillary value k_r		Factor due to influence of load f_F	Speed parameter n_K
over	incl.		
–	220	0,0080	1,65
220	280	0,0108	1,45
280	340	0,0135	1,25

The factor for determining the influence of speed relative to the reference speed n_B when using oil lubrication is defined as follows:

$$f_n = 0{,}5 \cdot \left(1 + \frac{n}{n_B \cdot n_K}\right), \text{ if } n < n_K \cdot n_B$$

$$f_n = 1, \text{ if } n \geqq n_K \cdot n_B$$

f_n –
Factor for determining the influence of speed,
in the case of full complement bearings: $f_n = 1$

n min^{-1}
Speed

n_B min^{-1}
Reference speed

n_K –
Speed parameter.

The requisite minimum load is as follows:

$$F_{r\,min} = f_F \cdot f_n \cdot C_0$$

$F_{r\,min}$ kN
Minimum radial load

f_F –
Factor due to influence of load

f_n –
Factor due to influence of speed

C_0 kN
Basic static load rating.

Higher minimum loads may be necessary under certain conditions when starting up at low temperature, when using greases with a high base oil viscosity and where bearings have been regreased.

Example 1

Calculation of the minimum load for the toroidal roller bearing C3144-XL-K-C4 at an operating speed of 260 min^{-1} with the aid of the diagram, *Figure 9*.

$$k_r = k_\delta \cdot d_M$$

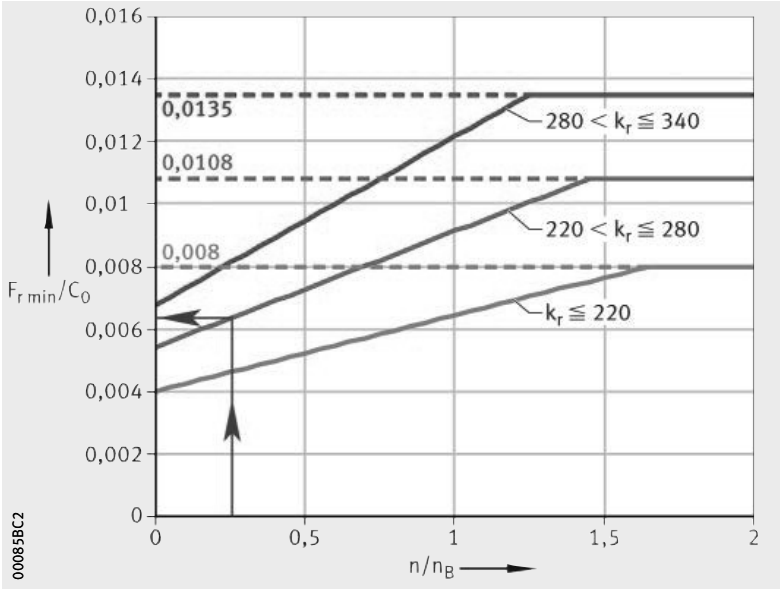
$$k_\delta = 0{,}791$$

$$d_M = \frac{220\ mm + 370\ mm}{2} = 295\ mm$$

$$k_r = 0{,}791 \cdot 295\ mm = 233{,}345\ mm \approx 233\ mm$$

$$\frac{n}{n_B} = \frac{260\ min^{-1}}{960\ min^{-1}} = 0{,}27$$

Since k_r = 233 mm, the green graph in the diagram is selected. n/n_B = 0,27 for $F_{r\,min}/C_0$ = 0,0064.



$F_{r\,min}$ = minimum radial load
C_0 = basic static load rating
n = speed
n_B = reference speed
k_r = ancillary value

Figure 9
Minimum load

For the toroidal roller bearing C3144-XL-K-C4 with C_0 = 2 900 kN, this gives:

$$F_{r\,min} = 0{,}0064 \cdot 2\,900\ kN = 18{,}6\ kN$$

Example 2

Calculation of the minimum load for the toroidal roller bearing C3144-XL-K-C4 at an operating speed of 260 min^{-1} and oil lubrication with the aid of table, page 17.

If $k_r \approx 233$ is taken from Example 1, this gives:

- $n_K = 1{,}45$
- $f_F = 0{,}0108$.

If $n_B \cdot n_K = 960\ min^{-1} \cdot 1{,}45 = 1\,392\ min^{-1} > 260\ min^{-1}$, this gives:

$$f_n = 0{,}5 \cdot \left(1 + \frac{n}{n_B \cdot n_K}\right)$$

$$f_n = 0{,}5 \cdot \left(1 + \frac{260\ min^{-1}}{960\ min^{-1} \cdot 1{,}45}\right) = 0{,}593$$

and

$$F_{r\,min} = f_F \cdot f_n \cdot C_0$$

$$F_{r\,min} = 0{,}0108 \cdot 0{,}593 \cdot 2\,900\ kN \approx 18{,}6\ kN$$

Speeds

The reference speed given in the bearing tables can be exceeded up to the level of the limiting speed if permitted by the operating conditions. In order to take account of special operating conditions, the thermally safe operating speed is determined, see Catalogue HR 1, Rolling Bearings.

Tolerances

Bearings with a cylindrical bore and tapered bore have normal tolerances in accordance with DIN 620-2:1988 and respectively ISO 492:2014.

The running accuracy for the inner ring and outer ring corresponds to the tolerance class 5.

Toroidal roller bearings

Design of bearing arrangements

Since toroidal roller bearings cannot support axial loads, the inner ring and outer ring must be axially located.

Axial location of bearings

In the case of toroidal roller bearings, the inner ring and outer ring must be axially located on both sides not only on the shaft but also in the housing bore. The bearing rings should therefore be mounted such that one side is in contact against a shoulder on the shaft or in the housing.

The other side of the inner ring can be axially located by means of:

- a shaft nut
- a retaining ring
- a screw mounted end washer on the end of the shaft.

The outer rings can normally be axially located and retained in the housing bore by means of the cover, *Figure 10*.

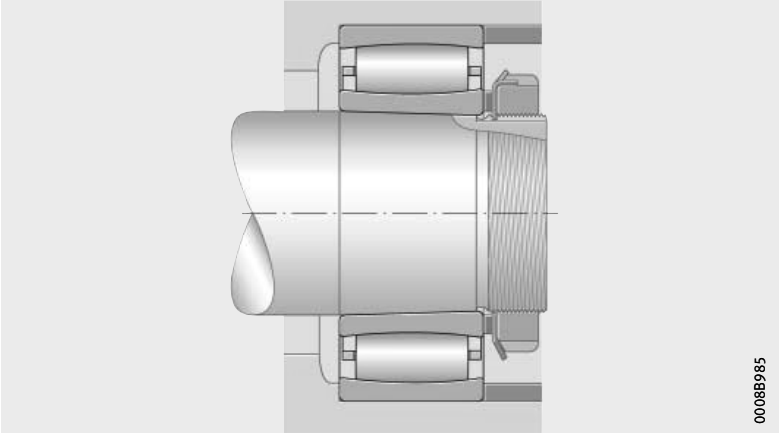


Figure 10
Retention by means of retaining nut

Fits

For toroidal roller bearings, the shaft and housing fits used should be on the same basis as in Catalogue HR 1, Rolling Bearings.

Accuracy of mating parts

The accuracy of the cylindrical bearing seats on shafts and in housings should correspond to the accuracy of the bearings used. For toroidal roller bearings, the tolerances used should be on the same basis as in Catalogue HR 1, Rolling Bearings, or specific recommendations for the application should be observed.

Free space

Toroidal roller bearings can compensate thermally-induced changes in the length of the shaft relative to the shaft within the bearing. In order to ensure the function of the bearing, free space must be provided on both end faces of the bearings, *Figure 11*.

For bearings with a cage, the minimum values we recommend for the depth of the free space are as follows:

$$C_{a\,req} = C_a + 0{,}5 \cdot \left(\delta_{ax} + s_\varphi\right)$$

$C_{a\,req}$ mm
Requisite value for the depth of the free space

C_a mm
Minimum value for depth of free space in the case of bearing rings without offset, see dimension table

δ_{ax} mm
Axial displacement from central position

s_φ mm
Reduction in axial displacement facility as a result of tilting.

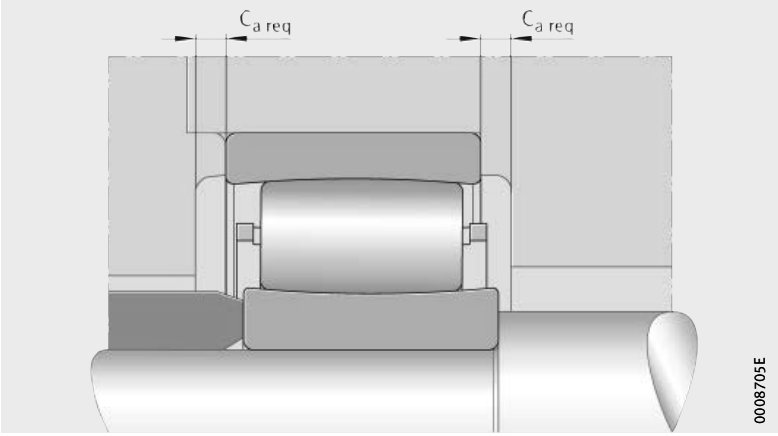


Figure 11
Free space in housing

In standard mounting, the bearing rings are fitted concentrically in relation to each other. If significant changes in length occur in one direction in the application due to heat, the inner ring can be fitted offset relative to the outer ring in the opposing direction by up to the maximum permissible axial displacement. As a result, there is a significant increase in the possible axial displacement.

Toroidal roller bearings can be axially located by means of shaft nuts KML or KM and tab washers MBL or MB, *Figure 10*, page 20. For bearings with a bore diameter larger than 200 mm, we recommend nuts of series HM30 with the tab washer MS30.

Toroidal roller bearings

In the axial location of toroidal roller bearings with retaining nuts, it must be ensured that the cage of the bearing does not graze the retaining nut or tab washer if the shaft undergoes axial displacements. The outside diameter of the retaining nut should always be smaller than the mounting dimension $d_{a\ max}$ indicated in the dimension table.

If this is not possible, an intermediate ring can be arranged between the bearing and means of retention and the thread on the shaft can be made correspondingly longer.

Mounting guidelines

The mounting and dismounting of toroidal roller bearings with a cylindrical bore and of smaller bearings with a tapered bore should be carried out in accordance with the guidelines indicated in our Catalogue HR 1, Rolling Bearings, in the section Mounting and dismounting. For the mounting and dismounting of larger bearings on a tapered journal or sleeve, we recommend the use of the hydraulic method, see Publication MH 1, Mounting of Rolling Bearings.

Toroidal roller bearings on adapter sleeve or withdrawal sleeve

Toroidal roller bearings with a tapered bore can be mounted on smooth or stepped shafts by means of an adapter sleeve or withdrawal sleeve, *Figure 12*. In the case of substantial axial displacements, it must be ensured that the axial displacement always occurs in the direction of the sleeve nut. General information on the mounting of rolling bearings on adapter sleeves and withdrawal sleeves can be found in Catalogue HR 1, Rolling Bearings.

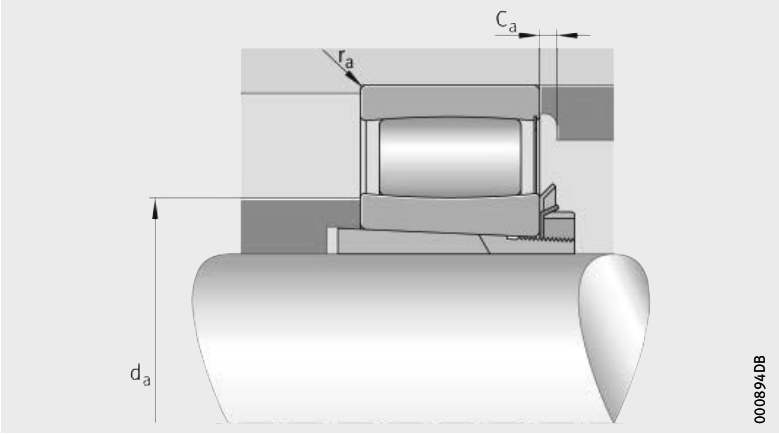


Figure 12
Toroidal roller bearing on adapter sleeve

Toroidal roller bearings

Reduced radial internal clearance in mounting

When bearings with a tapered bore are mounted, there is a reduction in the radial internal clearance.

The values indicated values ensure a secure seat on the shaft, see table.

Reduction in radial internal clearance of FAG toroidal roller bearings with tapered bore

Nominal bearing bore diameter d		Radial internal clearance before mounting Internal clearance group					
		Group N		Group 3		Group 4	
over mm	incl. mm	min. mm	max. mm	min. mm	max. mm	min. mm	max. mm
24	**30**	0,035	0,055	0,050	0,065	0,065	0,085
30	**40**	0,045	0,065	0,060	0,080	0,080	0,100
40	**50**	0,050	0,075	0,070	0,095	0,090	0,120
50	**65**	0,060	0,090	0,085	0,115	0,110	0,150
65	**80**	0,075	0,110	0,105	0,140	0,135	0,180
80	**100**	0,095	0,135	0,130	0,175	0,170	0,220
100	**120**	0,115	0,155	0,155	0,205	0,200	0,255
120	**140**	0,135	0,180	0,180	0,235	0,230	0,295
140	**160**	0,155	0,215	0,210	0,270	0,265	0,340
160	**180**	0,170	0,240	0,235	0,305	0,300	0,385
180	**200**	0,190	0,260	0,260	0,330	0,325	0,420
200	**225**	0,210	0,290	0,285	0,365	0,360	0,460
225	**250**	0,235	0,315	0,315	0,405	0,400	0,515
250	**280**	0,255	0,345	0,340	0,445	0,440	0,560
280	**315**	0,280	0,380	0,375	0,485	0,480	0,620
315	**355**	0,315	0,420	0,415	0,545	0,540	0,680
355	**400**	0,350	0,475	0,470	0,600	0,595	0,755
400	**450**	0,380	0,525	0,525	0,655	0,650	0,835
450	**500**	0,435	0,575	0,575	0,735	0,730	0,915
500	**560**	0,470	0,640	0,630	0,810	0,800	1,010
560	**630**	0,530	0,710	0,700	0,890	0,880	1,110
630	**710**	0,590	0,780	0,770	0,990	0,980	1,230
710	**800**	0,670	0,860	0,860	1,100	1,100	1,380
800	**900**	0,730	0,960	0,950	1,220	1,210	1,530
900	**1 000**	0,810	1,040	1,040	1,340	1,340	1,670
1 000	**1 120**	0,890	1,170	1,160	1,500	1,490	1,880
1 120	**1 250**	0,970	1,280	1,270	1,640	1,630	2,060
1 250	**1 400**	1,080	1,410	1,410	1,790	1,780	2,250
1 400	**1 600**	1,200	1,550	1,550	1,990	1,990	2,500
1 600	**1 800**	1,320	1,690	1,690	2,180	2,180	2,730

[1] Valid only for solid steel shafts and hollow shafts with a bore no larger than half the shaft diameter.
The following applies: Bearings with a radial internal clearance before mounting in the upper half of the tolerance range are mounted using the larger value for the reduction in radial internal clearance or the axial displacement distance, while bearings in the lower half of the tolerance range are mounted using the smaller value for the reduction in radial internal clearance or the axial displacement distance.

Reduction in radial internal clearance[1]		Displacement distance on taper 1:12[1] Shaft		Displacement distance on taper 1:30[1] Shaft		Control value for radial internal clearance after mounting		
						Group N	Group 3	Group 4
min.	max.	min.	max.	min.	max.	min.	min.	min.
mm	mm	mm	mm	mm	mm	mm	mm	mm
0,010	0,017	0,24	0,29	0,61	0,72	0,025	0,035	0,048
0,014	0,021	0,30	0,34	0,76	0,84	0,031	0,041	0,059
0,018	0,028	0,37	0,42	0,91	1,04	0,033	0,046	0,062
0,024	0,035	0,46	0,50	1,14	1,24	0,036	0,054	0,075
0,030	0,046	0,55	0,61	1,37	1,53	0,045	0,065	0,090
0,040	0,056	0,67	0,73	1,68	1,83	0,056	0,080	0,114
0,049	0,069	0,79	0,89	1,98	2,23	0,066	0,093	0,131
0,060	0,083	0,91	1,05	2,29	2,62	0,075	0,105	0,147
0,072	0,095	1,04	1,21	2,59	3,02	0,083	0,123	0,170
0,081	0,107	1,16	1,36	2,90	3,41	0,089	0,137	0,193
0,090	0,121	1,28	1,52	3,20	3,81	0,100	0,150	0,204
0,101	0,134	1,43	1,68	3,58	4,20	0,109	0,162	0,226
0,113	0,151	1,59	1,88	3,96	4,69	0,123	0,177	0,249
0,126	0,168	1,77	2,08	4,42	5,19	0,129	0,186	0,273
0,142	0,188	1,98	2,31	4,95	5,78	0,138	0,203	0,292
0,160	0,211	2,23	2,59	5,56	6,47	0,155	0,221	0,329
0,180	0,238	2,50	2,90	6,25	7,26	0,170	0,251	0,357
0,203	0,268	2,81	3,26	7,01	8,15	0,178	0,279	0,382
0,225	0,300	3,11	3,66	7,78	9,14	0,210	0,300	0,430
0,250	0,335	3,48	4,05	8,69	10,13	0,220	0,325	0,465
0,285	0,375	3,90	4,52	9,76	11,31	0,245	0,355	0,505
0,320	0,420	4,39	5,08	10,98	12,69	0,270	0,380	0,560
0,360	0,475	4,94	5,71	12,35	14,27	0,310	0,425	0,625
0,405	0,535	5,55	6,42	13,88	16,05	0,325	0,460	0,675
0,450	0,605	6,16	7,21	15,40	18,03	0,360	0,490	0,735
0,505	0,670	6,89	8,00	17,23	20,00	0,385	0,545	0,820
0,565	0,750	7,69	8,95	19,21	22,37	0,410	0,580	0,880
0,630	0,840	8,60	9,98	21,50	24,94	0,450	0,640	0,940
0,720	0,940	9,82	11,16	24,55	27,90	0,480	0,685	1,050
0,810	1,070	11,04	12,74	27,60	31,85	0,510	0,705	1,110

Toroidal roller bearings

Accuracy

The main dimensions of the toroidal roller bearings listed in the dimension tables match the data in DIN 616:1994 and ISO 15:1981 respectively.

Radial internal clearance

The values for the radial internal clearance of bearings with a cylindrical bore, see table, and those for bearings with a tapered bore, see table, page 28, are valid for unmounted bearings with a measurement load of zero.

Axial displacements of the bearing rings relative to each other will reduce the internal clearance of toroidal roller bearings. This reduction can be determined, see page 12.

Radial internal clearance of bearings with cylindrical bore

Bore d mm		Radial internal clearance			
		Group 2 µm		Group N µm	
over	incl.	min.	max.	min.	max.
18	24	15	30	25	40
24	30	15	35	30	50
30	40	20	40	35	55
40	50	25	45	45	65
50	65	30	55	50	80
65	80	40	70	65	100
80	100	50	85	80	120
100	120	60	100	100	145
120	140	75	120	115	170
140	160	85	140	135	195
160	180	95	155	150	220
180	200	105	175	170	240
200	225	115	190	185	265
225	250	125	205	200	285
250	280	135	225	220	310
280	315	150	240	235	330
315	355	160	260	255	360
355	400	175	280	280	395
400	450	190	310	305	435
450	500	205	335	335	475
500	560	220	360	360	520
560	630	240	400	390	570
630	710	260	440	430	620
710	800	300	500	490	680
800	900	320	540	530	760
900	1 000	370	600	590	830
1 000	1 120	410	660	660	930
1 120	1 250	450	720	720	1 020
1 250	1 400	490	800	800	1 130
1 400	1 600	570	890	890	1 250
1 600	1 800	650	1 010	1 010	1 390

Radial internal clearance of bearings with cylindrical bore (continued)

Bore d mm		Radial internal clearance					
		Group 3 µm		Group 4 µm		Group 5 µm	
over	incl.	min.	max.	min.	max.	min.	max.
18	24	35	55	50	65	65	85
24	30	45	60	60	80	75	95
30	40	55	75	70	95	90	120
40	50	65	85	85	110	105	140
50	65	75	105	100	140	135	175
65	80	95	125	120	165	160	210
80	100	120	160	155	210	205	260
100	120	140	190	185	245	240	310
120	140	165	215	215	280	280	350
140	160	195	250	250	325	320	400
160	180	215	280	280	365	360	450
180	200	235	310	305	395	390	495
200	225	260	340	335	435	430	545
225	250	280	370	365	480	475	605
250	280	305	410	405	520	515	655
280	315	330	435	430	570	570	715
315	355	360	485	480	620	620	790
355	400	395	530	525	675	675	850
400	450	435	580	575	745	745	930
450	500	475	635	630	815	810	1 015
500	560	510	690	680	890	890	1 110
560	630	560	760	750	980	970	1 220
630	710	610	840	830	1 080	1 070	1 340
710	800	680	920	920	1 200	1 200	1 480
800	900	750	1 020	1 010	1 330	1 320	1 660
900	1 000	830	1 120	1 120	1 460	1 460	1 830
1 000	1 120	930	1 260	1 260	1 640	1 640	2 040
1 120	1 250	1 020	1 380	1 380	1 800	1 800	2 240
1 250	1 400	1 130	1 510	1 540	1 970	1 970	2 460
1 400	1 600	1 250	1 680	1 680	2 200	2 200	2 740
1 600	1 800	1 390	1 870	1 870	2 430	2 430	3 000

Radial internal clearance of bearings with tapered bore

Bore d mm		Radial internal clearance			
		Group 2 µm		Group N µm	
over	incl.	min.	max.	min.	max.
18	24	15	35	30	45
24	30	20	40	35	55
30	40	25	50	45	65
40	50	30	55	50	75
50	65	40	65	60	90
65	80	50	80	75	110
80	100	60	100	95	135
100	120	75	115	115	155
120	140	90	135	135	180
140	160	100	155	155	215
160	180	115	175	170	240
180	200	130	195	190	260
200	225	140	215	210	290
225	250	160	235	235	315
250	280	170	260	255	345
280	315	195	285	280	380
315	355	220	320	315	420
355	400	250	350	350	475
400	450	280	385	380	525
450	500	305	435	435	575
500	560	330	480	470	640
560	630	380	530	530	710
630	710	420	590	590	780
710	800	480	680	670	860
800	900	520	740	730	960
900	1 000	580	820	810	1 040
1 000	1 120	640	900	890	1 170
1 120	1 250	700	980	970	1 280
1 250	1 400	770	1 080	1 080	1 410
1 400	1 600	870	1 200	1 200	1 550
1 600	1 800	950	1 320	1 320	1 690

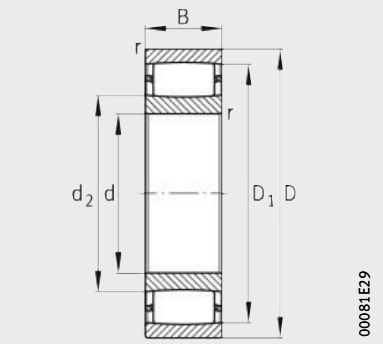
Radial internal clearance of bearings with tapered bore (continued)

Bore d mm		Radial internal clearance					
		Group 3 µm		Group 4 µm		Group 5 µm	
over	incl.	min.	max.	min.	max.	min.	max.
18	24	40	55	55	70	65	85
24	30	50	65	65	85	80	100
30	40	60	80	80	100	100	125
40	50	70	95	90	120	115	145
50	65	85	115	110	150	145	185
65	80	105	140	135	180	175	220
80	100	130	175	170	220	215	275
100	120	155	205	200	255	255	325
120	140	180	235	230	295	290	365
140	160	210	270	265	340	335	415
160	180	235	305	300	385	380	470
180	200	260	330	325	420	415	520
200	225	285	365	360	460	460	575
225	250	315	405	400	515	510	635
250	280	340	445	440	560	555	695
280	315	375	485	480	620	615	765
315	355	415	545	540	680	675	850
355	400	470	600	595	755	755	920
400	450	525	655	650	835	835	1 005
450	500	575	735	730	915	910	1 115
500	560	630	810	800	1 010	1 000	1 230
560	630	700	890	880	1 110	1 110	1 350
630	710	770	990	980	1 230	1 230	1 490
710	800	860	1 100	1 100	1 380	1 380	1 660
800	900	950	1 220	1 210	1 530	1 520	1 860
900	1 000	1 040	1 340	1 340	1 670	1 670	2 050
1 000	1 120	1 160	1 500	1 490	1 880	1 870	2 280
1 120	1 250	1 270	1 640	1 630	2 060	2 050	2 500
1 250	1 400	1 410	1 790	1 780	2 250	2 250	2 740
1 400	1 600	1 550	1 990	1 990	2 500	2 500	3 050
1 600	1 800	1 690	2 180	2 180	2 730	2 730	3 310

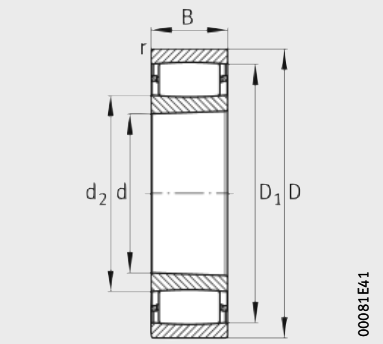
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

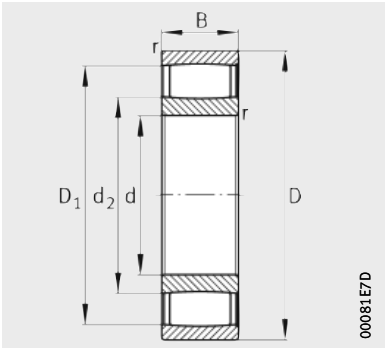


Tapered bore

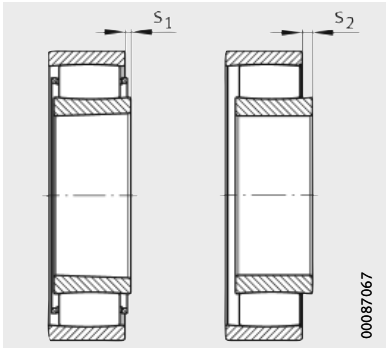
Dimension table · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C2205-XL-K-V	0,181	**25**	52	18	1	43,3	32,1	46,4	–	38	30,6
C2205-XL-V	0,175	**25**	52	18	1	43,3	32,1	46,4	–	38	30,6
C2206-XL-V	0,276	**30**	62	20	1	53,1	37,4	56,4	–	46	35,6
C2206-XL-K-V	0,284	**30**	62	20	1	53,1	37,4	56,4	–	46	35,6
C2207-XL-K-V	0,439	**35**	72	23	1,1	60,7	44,8	65	–	53	42
C2207-XL-V	0,427	**35**	72	23	1,1	60,7	44,8	65	–	53	42
C2208-XL-K-V	0,533	**40**	80	23	1,1	69,9	52,4	73	–	60	47
C2208-XL-V	0,518	**40**	80	23	1,1	69,9	52,4	73	–	60	47
C2209-XL-K-V	0,577	**45**	85	23	1,1	73,1	55,6	78	–	65	52
C2209-XL-V	0,561	**45**	85	23	1,1	73,1	55,6	78	–	65	52
C4010-XL-K30-V	0,565	**50**	80	30	1	70,8	57,6	75,4	–	65	54,6
C4010-XL-V	0,548	**50**	80	30	1	70,8	57,6	75,4	–	65	54,6
C2210-XL-K-V	0,621	**50**	90	23	1,1	79,4	61,9	83	–	70	57
C2210-XL-V	0,604	**50**	90	23	1,1	79,4	61,9	83	–	70	57
C2211-XL-K-V	0,841	**55**	100	25	1,5	86,7	65,8	91	–	77	64
C2211-XL-V	0,817	**55**	100	25	1,5	86,7	65,8	91	–	77	64
C2212-XL-K-V	1,15	**60**	110	28	1,5	97,9	77,1	101	–	85	69
C2212-XL-V	1,12	**60**	110	28	1,5	97,9	77,1	101	–	85	69
C4013-XL-K30-V	0,975	**65**	100	35	1	89,1	74,2	95,4	–	82	69,6
C4013-XL-V	0,947	**65**	100	35	1,1	89,1	74,2	94	–	82	71
C2213-XL-K-V	1,48	**65**	120	31	1,5	106	79	111	–	92	74
C2213-XL-V	1,52	**65**	120	31	1,5	106	79	111	–	92	74
C2214-XL-K-V	1,6	**70**	125	31	1,5	111	83,7	116	–	97	79
C2214-XL-V	1,56	**70**	125	31	1,5	111	83,7	116	–	97	79
C2314-XL	4,33	**70**	150	51	2,1	130	91,4	138	121	105	82
C2314-XL-K	4,21	**70**	150	51	2,1	130	91,4	138	121	105	82

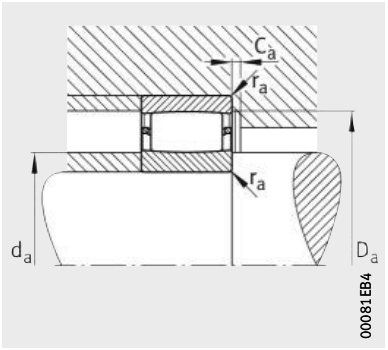
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



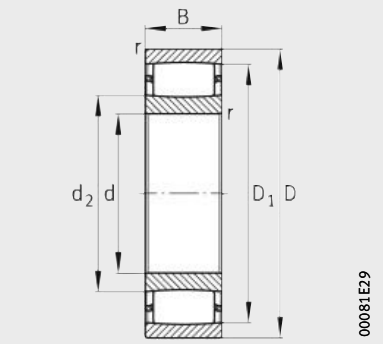
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
–	1	5,8	2,8	51	48,5	1,565	7,062	7,5	6 700	–
–	1	5,8	2,8	51	48,5	1,565	7,062	7,5	6 700	–
–	1	4,5	1,5	79	73	1,962	5,572	11,3	5 500	–
–	1	4,5	1,5	79	73	1,962	5,572	11,3	5 500	–
–	1	5,7	2,7	98	98	2,113	5,282	14,5	4 900	–
–	1	5,7	2,7	98	98	2,113	5,282	14,5	4 900	–
–	1	7,1	4,1	105	106	2,28	5	17,3	4 350	–
–	1	7,1	4,1	105	106	2,28	5	17,3	4 350	–
–	1	7,1	4,1	109	112	2,306	5	18,4	4 200	–
–	1	7,1	4,1	109	112	2,308	5	18,4	4 200	–
–	1	6	3	137	180	2,996	3,581	22,4	4 400	–
–	1	6	3	137	180	2,996	3,581	22,4	4 400	–
–	1	7,1	3,9	116	125	2,541	4,536	20,6	3 700	–
–	1	7,1	3,9	116	125	2,541	4,536	20,6	3 700	–
–	1,5	8,6	5,4	135	138	2,656	4,386	22,2	3 200	–
–	1,5	8,6	5,4	135	138	2,656	4,386	22,2	3 200	–
–	1,5	8,5	5,3	171	195	3,116	3,713	32,5	2 650	–
–	1,5	8,5	5,3	171	195	3,116	3,713	32,5	2 650	–
–	1	6	2,3	197	285	3,543	3,082	33,5	3 050	–
–	1	6	2,8	197	285	3,543	3,082	33,5	3 050	–
–	1,5	9,6	5,3	208	216	3,298	3,505	36	2 340	–
–	1,5	9,6	5,3	208	216	3,298	3,505	36	2 340	–
–	1,5	9,6	5,3	215	229	3,523	3,265	38	2 180	–
–	1,5	9,6	5,3	215	229	3,523	3,265	38	2 180	–
1,4	2	9,1	–	405	440	5,478	1,941	52	6 000	3 200
1,4	2	9,1	–	405	440	5,478	1,941	52	6 000	3 200

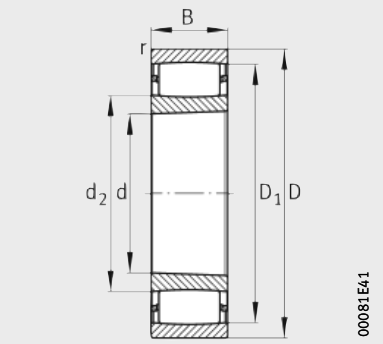
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

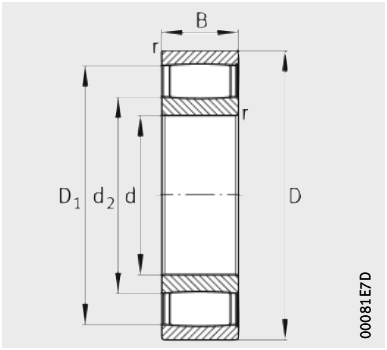


Tapered bore

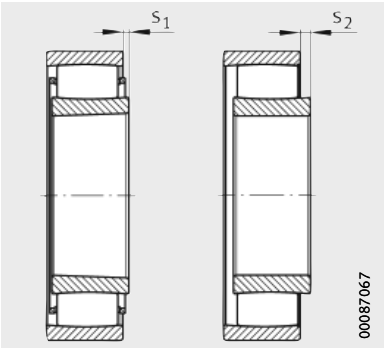
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C4015-XL-K30-V	1,47	**75**	115	40	1,1	101	88,7	109	–	95	81
C4015-XL-V	1,43	**75**	115	40	1,1	101	88,7	109	–	95	81
C2215-XL	1,69	**75**	130	31	1,5	115	88,5	121	110	96	84
C2215-XL-K	1,64	**75**	130	31	1,5	115	88,5	121	110	96	84
C2215-XL-K-V	1,64	**75**	130	31	1,5	115	88,5	121	–	102	84
C2215-XL-V	1,69	**75**	130	31	1,5	115	88,5	121	–	102	84
C2315-XL	5,3	**75**	160	55	2,1	135	98,5	148	127	111	87
C2315-XL-K	5,15	**75**	160	55	2,1	135	98,5	148	127	111	87
C2316-XL	6,3	**80**	170	58	2,1	145	102	158	135	117	92
C2316-XL-K	6,3	**80**	170	58	2,1	145	102	158	135	117	92
C2217-XL-V	2,65	**85**	150	36	2	133	104	139	–	117	96
C2217-XL-K-V	2,58	**85**	150	36	2	133	104	139	–	117	96
C2217-XL	2,65	**85**	150	36	2	133	104	139	126	113	96
C2217-XL-K	2,58	**85**	150	36	2	133	104	139	126	113	96
C2317-XL	7,29	**85**	180	60	3	153	110	166	143	125	99
C2317-XL-K	7,08	**85**	180	60	3	153	110	166	143	125	99
C2218-XL-K	3,28	**90**	160	40	2	144	112	149	137	122	101
C2218-XL	3,38	**90**	160	40	2	144	112	149	137	122	101
C2318-XL-K	8,4	**90**	190	64	3	166	119	176	154	136	104
C2318-XL	8,65	**90**	190	64	3	166	119	176	154	136	104
C2219-XL-K	4,01	**95**	170	43	2,1	149	113	158	140	125	107
C2219-XL	4,12	**95**	170	43	2,1	149	113	158	140	125	107
C2319-XL-K	9,73	**95**	200	67	3	166	120	186	155	137	109
C2319-XL	10	**95**	200	67	3	166	120	186	155	137	109
C4020-XL-K30-V	3,02	**100**	150	50	1,5	135	113	143	–	125	107
C4020-XL-V	2,93	**100**	150	50	1,5	135	113	143	–	125	107
C2220-XL	4,97	**100**	180	46	2,1	157	118	168	147	131	112
C2220-XL-K	4,83	**100**	180	46	2,1	157	118	168	147	131	112
C2222-XL-K	6,93	**100**	200	53	2	179	136	189	168	150	111
C2222-XL	7,13	**100**	200	53	2	179	136	189	168	150	111
C2320-XL-K	12,4	**100**	215	73	3	185	126	201	169	148	114
C2320-XL	12,8	**100**	215	73	3	185	126	201	169	148	114

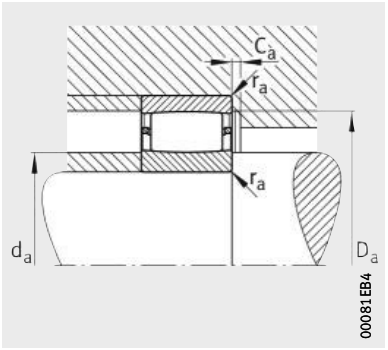
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



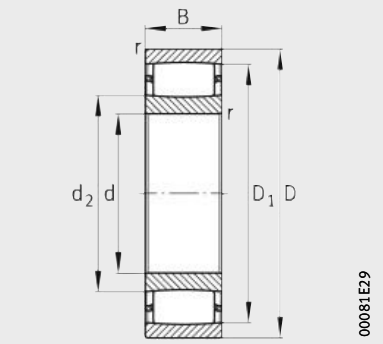
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
–	1	9,4	5,1	209	355	3,893	2,845	39,5	2 470	–
–	1	9,4	5,1	209	355	3,893	2,845	39,5	2 470	–
1,1	1,5	9,6	–	197	207	3,561	3,267	33	7 000	3 250
1,1	1,5	9,6	–	197	207	3,561	3,267	33	7 000	3 250
–	1,5	9,6	5,3	221	241	3,561	3,267	38,5	2 050	–
–	1,5	9,6	5,3	221	241	3,561	3,267	38,5	2 050	–
1,5	2	13,1	–	430	470	5,53	1,941	56	5 600	3 200
1,5	2	13,1	–	430	470	5,53	1,941	56	5 600	3 200
1,7	2	10,1	–	510	550	6,094	1,745	62	5 100	3 050
1,7	2	10,1	–	510	550	6,094	1,745	62	5 100	3 050
–	2	7,1	1,7	315	395	4,194	2,763	59	1 640	–
–	2	7,1	1,7	315	395	4,194	2,763	59	1 640	–
1,1	2	7,1	–	275	330	4,194	2,763	49	5 900	2 750
1,1	2	7,1	–	275	330	4,194	2,763	49	5 900	2 750
1,7	2,5	12,1	–	550	610	6,144	1,752	68	4 800	2 850
1,7	2,5	12,1	–	550	610	6,144	1,752	68	4 800	2 850
1,3	2	9,5	–	330	380	4,103	2,924	55	5 300	2 650
1,3	2	9,5	–	330	380	4,103	2,924	55	5 300	2 650
1,9	2,5	9,6	–	650	740	6,791	1,578	77	4 350	2 500
1,9	2,5	9,6	–	650	740	6,791	1,578	77	4 350	2 500
1,5	2	10,5	–	370	405	4,75	2,42	61	5 000	2 750
1,5	2	10,5	–	370	405	4,75	2,42	61	5 000	2 750
1,8	2,5	12,6	–	660	750	6,765	1,587	78	4 350	2 600
1,8	2,5	12,6	–	660	750	6,765	1,587	78	4 350	2 600
–	1,5	14	9,7	355	530	4,766	2,365	66	1 580	–
–	1,5	14	9,7	355	530	4,766	2,365	66	1 580	–
1,6	2	10,1	–	420	470	4,849	2,393	68	4 700	2 700
1,6	2	10,1	–	420	470	4,849	2,393	68	4 700	2 700
1,7	2	11,1	–	550	650	5,857	1,945	89	4 050	2 330
1,7	2	11,1	–	550	650	5,857	1,945	89	4 050	2 330
2,2	2,5	11,2	–	820	920	8,026	1,312	97	3 850	2 290
2,2	2,5	11,2	–	820	920	8,026	1,312	97	3 850	2 290

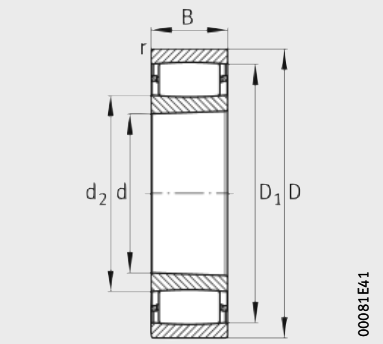
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

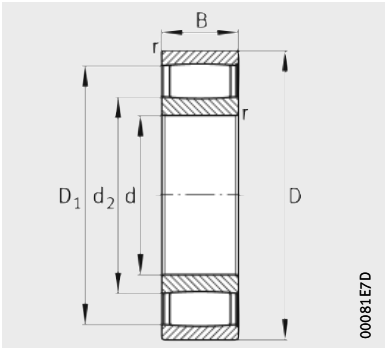


Tapered bore

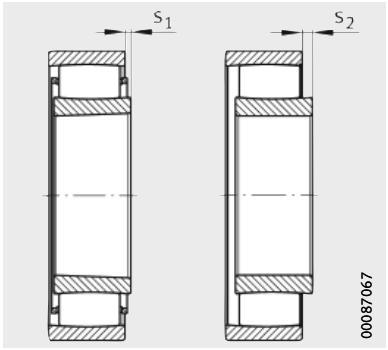
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C3022-XL	3,65	**110**	170	45	2	156	128	161,2	151	136	118,8
C3022-XL-K	3,54	**110**	170	45	2	156	128	161,2	151	136	118,8
C4022-XL-V	4,73	**110**	170	60	2	150	126	161,2	–	140	118,8
C4022-XL-K30-V	4,86	**110**	170	60	2	150	126	161,2	–	140	118,8
C4122-XL-K30-V	6,76	**110**	180	69	2	163	132	169	–	145	121
C4122-XL-V	6,57	**110**	180	69	2	163	132	169	–	145	121
C3024-XL-V	4	**120**	180	46	2	166	138	171,2	–	150	128,8
C3024-XL-K-V	3,88	**120**	180	46	2	166	138	171,2	–	150	128,8
C3024-XL	4	**120**	180	46	2	166	138	171,2	161	146	128,8
C3024-XL-K	3,88	**120**	180	46	2	166	138	171,2	161	146	128,8
C4024-XL-K30-V	5,2	**120**	180	60	2	166	142	171	–	150	150
C4024-XL-V	5,2	**120**	180	60	2	166	142	171	–	150	150
C4124-XL-K30-V	9,88	**120**	200	80	2	176	140	189	–	160	131
C4124-XL-V	9,6	**120**	200	80	2	176	140	189	–	160	131
C2224-XL	8,91	**120**	215	58	2,1	191	144	203	178	160	132
C2224-XL-K	8,65	**120**	215	58	2,1	191	144	203	178	160	132
C3224-XL-K	11,3	**120**	215	76	2,1	190	149	203	180	162	132
C3224-XL	11,7	**120**	215	76	2,1	190	149	203	180	162	132
C3026-XL-K	5,63	**130**	200	52	2	180	154	191,2	176	161	138,8
C3026-XL	5,8	**130**	200	52	2	180	154	191,2	176	161	138,8
C4026-XL-K30	7,47	**130**	200	69	2	181	149	191,2	174	159	138,8
C4026-XL-K30-V	7,47	**130**	200	69	2	181	149	191,2	–	165	138,8
C4026-XL-V	8,05	**130**	200	69	2	181	149	191,2	–	165	138,8
C4026-XL	7,69	**130**	200	69	2	181	149	191,2	174	159	138,8
C2226-XL	11,1	**130**	230	64	3	199	152	216	186	168	144
C2226-XL-K	10,8	**130**	230	64	3	199	152	216	186	168	144

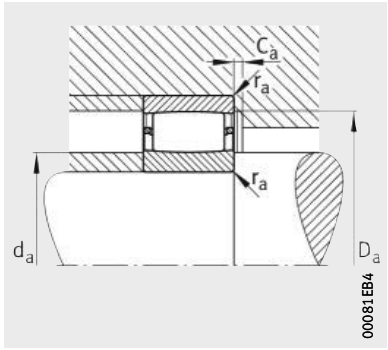
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



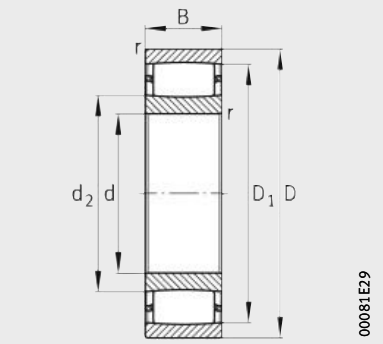
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
1,1	2	9,5	–	355	470	5,707	1,954	62	4 800	2 490
1,1	2	9,5	–	355	470	5,707	1,954	62	4 800	2 490
–	2	12	6,6	510	800	6,291	1,715	89	1 320	–
0,2	2	12	6,6	510	800	6,291	1,715	89	1 320	–
–	2	11,4	4,6	680	1 000	7,471	1,411	109	1 160	–
–	2	11,4	4,6	680	1 000	7,471	1,411	109	1 160	–
–	2	10,6	3,8	435	630	6,176	1,799	83	1 140	–
–	2	10,6	3,8	435	630	6,176	1,799	83	1 140	–
1	2	10,6	–	390	550	6,176	1,799	72	4 450	2 290
1	2	10,6	–	390	550	6,176	1,799	72	4 450	2 290
–	2	12	5,2	550	890	6,421	1,717	99	1 120	–
–	2	12	5,2	550	890	6,421	1,717	99	1 120	–
–	2	18	11,2	780	1 140	8,146	1,289	124	1 030	–
–	2	18	11,2	780	1 140	8,146	1,289	124	1 030	–
1,9	2	13	–	630	740	6,372	1,778	101	3 700	2 200
1,9	2	13	–	630	740	6,372	1,778	101	3 700	2 200
1,5	2	17,1	–	760	1 000	7,65	1,423	92	3 700	1 960
1,5	2	17,1	–	760	1 000	7,65	1,423	92	3 700	1 960
0,8	2	16,5	–	400	600	6,777	1,641	79	4 000	2 210
0,8	2	16,5	–	400	600	6,777	1,641	79	4 000	2 210
0,5	2	11,4	–	650	970	7,649	1,405	106	3 950	1 690
–	2	11,4	4,6	730	1 130	7,649	1,405	124	990	–
–	2	11,4	4,6	730	1 130	7,649	1,405	124	990	–
0,5	2	11,4	–	650	970	7,649	1,405	106	3 950	1 690
1,8	2,5	9,6	–	760	970	7,089	1,571	119	3 550	2 040
1,8	2,5	9,6	–	760	970	7,089	1,571	119	3 550	2 040

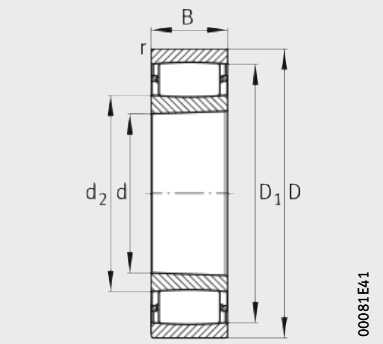
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

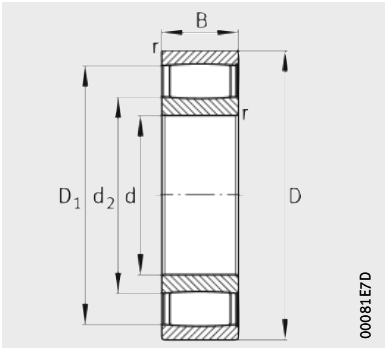


Tapered bore

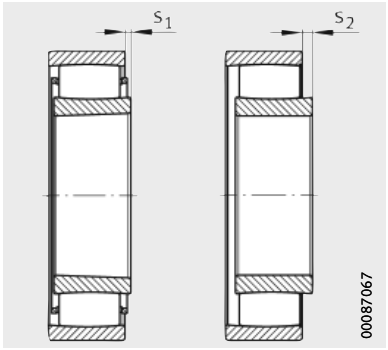
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C3028-XL-K	6,09	**140**	210	53	2	194	163	201,2	188	172	148,8
C3028-XL	6,27	**140**	210	53	2	194	163	201,2	188	172	148,8
C4028-XL-V	8,16	**140**	210	69	2	193	161	201,2	–	175	148,8
C4028-XL-K30-V	7,92	**140**	210	69	2	193	161	201,2	–	175	148,8
C4128-XL-K30-V	12,7	**140**	225	85	2,1	203	167	213	–	182	152
C4128-XL-V	12,4	**140**	225	85	2,1	203	167	213	–	182	152
C2228-XL	14,1	**140**	250	68	3	223	173	236	210	190	154
C2228-XL-K	13,7	**140**	250	68	3	223	173	236	210	190	154
C3030-XL-V	7,6	**150**	225	56	2,1	204	174	214,8	–	187	160,2
C3030-XL-K-M1B	7,38	**150**	225	56	2,1	204	173	214,8	199	183	160,2
C3030-XL-K-V	7,38	**150**	225	56	2,1	204	174	214,8	–	188	160,2
C3030-XL-M1B	7,6	**150**	225	56	2,1	204	173	214,8	199	183	160,2
C4030-XL-K30-V	9,89	**150**	225	75	2,1	204	173	214,8	–	187	160,2
C4030-XL-V	10,2	**150**	225	75	2,1	204	173	214,8	–	187	160,2
C3130-XL-K	15	**150**	250	80	2,1	226	182	238	215	197	162
C3130-XL	15,4	**150**	250	80	2,1	226	182	238	215	197	162
C4130-XL-K30-V	19,3	**150**	250	100	2,1	222	179	238	–	200	162
C4130-XL-V	18,8	**150**	250	100	2,1	222	179	238	–	200	162
C2230-XL	17,8	**150**	270	73	3	236	177	256	220	197	164
C2230-XL-K	17,2	**150**	270	73	3	236	177	256	220	197	164
C3032-XL	9,26	**160**	240	60	2,1	218	187	229,8	212	196	170,2
C3032-XL-K	9	**160**	240	60	2,1	218	187	229,8	212	196	170,2
C4032-XL-K30-V	12	**160**	240	80	2,1	217	181	229,8	–	200	170,2
C4032-XL-V	12,4	**160**	240	80	2,1	217	181	229,8	–	200	170,2
C4032-XL-K30	12	**160**	240	80	2,1	217	181	229,8	210	192	170,2
C4032-XL	12,4	**160**	240	80	2,1	217	181	229,8	210	192	170,2
C4132-XL-K30-V	24,9	**160**	270	109	2,1	241	190	258	–	215	172
C4132-XL-V	24,2	**160**	270	109	2,1	241	190	258	–	215	172

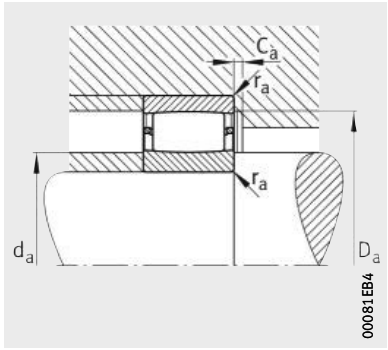
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



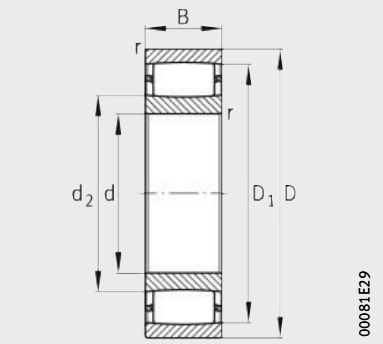
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
1,2	2	11	–	510	750	7,077	1,582	91	3 650	1 920
1,2	2	11	–	510	750	7,077	1,582	91	3 650	1 920
–	2	11,4	5,9	760	1 220	7,753	1,405	131	890	–
–	2	11,4	5,9	760	1 220	7,753	1,405	131	890	–
–	2	12	5,2	1 020	1 590	9,241	1,144	157	810	–
–	2	12	5,2	1 020	1 590	9,241	1,144	157	810	–
1,9	2,5	13,7	–	830	1 080	7,399	1,54	126	3 050	1 750
1,9	2,5	13,7	–	830	1 080	7,399	1,54	126	3 050	1 750
–	2	14,1	7,3	600	960	7,535	1,483	117	810	–
1	2	8,7	–	540	840	7,535	1,483	103	3 400	1 800
–	2	14,1	7,3	600	960	7,535	1,483	117	810	–
1	2	8,7	–	540	840	7,535	1,483	103	3 400	1 800
–	2	17,4	10,6	780	1 320	7,81	1,415	132	810	–
–	2	17,4	10,6	780	1 320	7,81	1,415	132	810	–
0,9	2	13,9	–	920	1 310	9,371	1,15	138	3 000	1 610
0,9	2	13,9	–	920	1 310	9,371	1,15	138	3 000	1 610
–	2	20	10,1	1 240	1 880	10,21	1,031	186	710	–
–	2	20	10,1	1 240	1 880	10,21	1,031	186	710	–
2,4	2,5	11,2	–	1 010	1 240	8,45	1,313	152	2 850	1 680
2,4	2,5	11,2	–	1 010	1 240	8,45	1,313	152	2 850	1 680
0,6	2	15	–	610	980	8,127	1,373	115	3 150	1 640
0,6	2	15	–	610	980	8,127	1,373	115	3 150	1 640
–	2	18,1	8,2	910	1 470	8,521	1,286	158	740	–
–	2	18,1	8,2	910	1 470	8,521	1,286	158	740	–
0,5	2	18,1	–	790	1 230	8,521	1,286	132	3 150	1 380
0,5	2	18,1	–	790	1 230	8,521	1,286	132	3 150	1 380
–	2	21	11,1	1 470	2 200	10,886	0,969	211	630	–
–	2	21	11,1	1 470	2 200	10,886	0,969	211	630	–

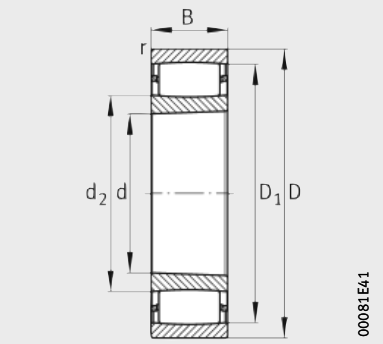
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

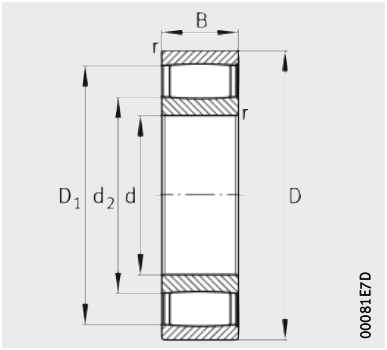


Tapered bore

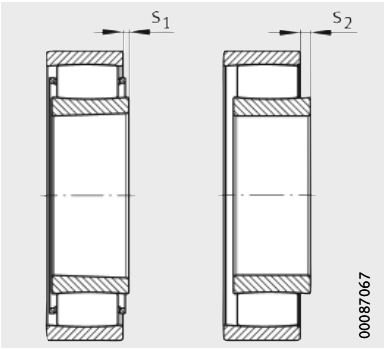
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C3034-XL	12,5	**170**	260	67	2,1	237	200	249,8	229	211	180,2
C3034-XL-K	12,2	**170**	260	67	2,1	237	200	249,8	229	211	180,2
C4034-XL-K30-V	16,8	**170**	260	90	2,1	235	195	249,8	–	215	180,2
C4034-XL-V	16,3	**170**	260	90	2,1	235	195	249,8	–	215	180,2
C3134-XL-K	20,4	**170**	280	88	2,1	249	200	268	237	216	182
C3134-XL	21	**170**	280	88	2,1	249	200	268	237	216	182
C4134-XL-K30-V	26	**170**	280	109	2,1	251	200	268	–	225	182
C4134-XL-V	25,3	**170**	280	109	2,1	251	200	268	–	225	182
C2234-XL	27,9	**170**	310	86	4	274	209	293	257	231	187
C2234-XL-K	27,1	**170**	310	86	4	274	209	293	257	231	187
C3036-XL	16,4	**180**	280	74	2,1	251	209	269,8	241	223	190,2
C3036-XL-K	16	**180**	280	74	2,1	251	209	269,8	241	223	190,2
C4036-XL-K30-V	22,2	**180**	280	100	2,1	247	203	269,8	–	230	190,2
C4036-XL-V	21,6	**180**	280	100	2,1	247	203	269,8	–	230	190,2
C3136-XL-K	25,9	**180**	300	96	3	266	210	286	257	234	194
C3136-XL	26,7	**180**	300	96	3	266	210	286	257	234	194
C4136-XL-K30-V	32,8	**180**	300	118	3	265	211	286	–	240	194
C4136-XL-V	31,9	**180**	300	118	3	265	211	286	–	240	194
C3236-XL-K	36,8	**180**	320	112	4	289	228	303	274	248	197
C3236-XL	37,8	**180**	320	112	4	289	228	303	274	248	197

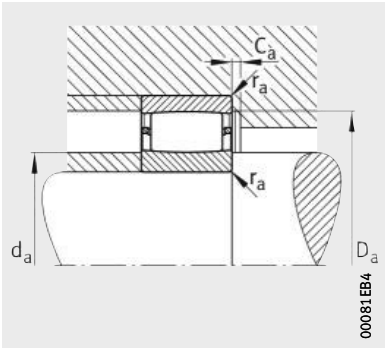
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



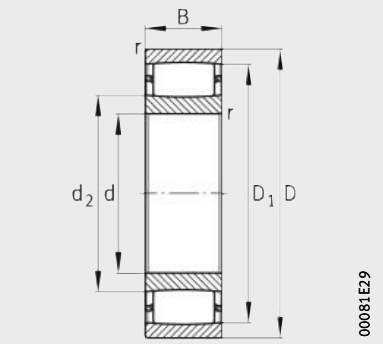
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
0,8	2	12,5	–	770	1 200	7,129	1,672	138	2 850	1 480
0,8	2	12,5	–	770	1 200	7,129	1,672	138	2 850	1 480
–	2	17,1	7,2	1 140	1 880	9,496	1,145	187	650	–
–	2	17,1	7,2	1 140	1 880	9,496	1,145	187	650	–
1,7	2	21	–	1 060	1 490	8,985	1,243	152	2 650	1 470
1,7	2	21	–	1 060	1 490	8,985	1,243	152	2 650	1 470
–	2	21	11,1	1 540	2 310	10,948	0,971	223	580	–
–	2	21	11,1	1 540	2 310	10,948	0,971	223	580	–
2,8	3	16,4	–	1 310	1 630	9,631	1,16	202	2 340	1 390
2,8	3	16,4	–	1 310	1 630	9,631	1,16	202	2 340	1 390
1,5	2	15,1	–	900	1 360	8,752	1,294	167	2 650	1 420
1,5	2	15,1	–	900	1 360	8,798	1,286	141	2 650	1 420
–	2	20,1	10,2	1 330	2 140	10,437	1,029	212	600	–
–	2	20,1	10,2	1 330	2 140	10,437	1,029	212	600	–
2,1	2,5	23,2	–	1 300	1 780	9,634	1,162	216	2 380	1 310
2,1	2,5	23,2	–	1 300	1 780	9,634	1,162	216	2 380	1 310
–	2,5	20	10,1	1 780	2 700	11,41	0,935	242	530	–
–	2,5	20	10,1	1 780	2 700	11,41	0,935	242	530	–
2,1	3	27,3	–	1 570	2 220	11,737	0,926	255	2 200	1 110
2,1	3	27,3	–	1 570	2 220	11,737	0,926	255	2 200	1 110

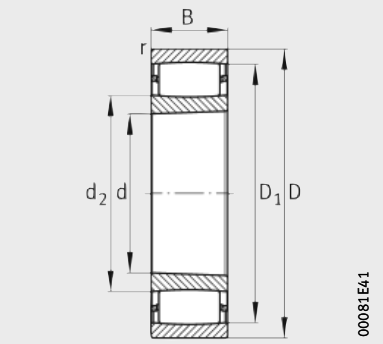
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

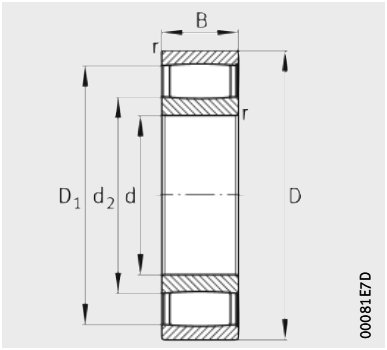


Tapered bore

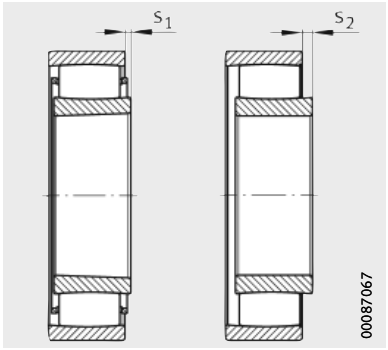
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C3038-XL	17,4	**190**	290	75	2,1	266	225	279,8	256	238	200,2
C3038-XL-K	16,9	**190**	290	75	2,1	266	225	279,8	256	238	200,2
C4038-XL-K30-V	23,2	**190**	290	100	2,1	263	220	279,8	–	240	200,2
C4038-XL-V	22,5	**190**	290	100	2,1	263	220	279,8	–	240	200,2
C3138-XL-K	32,3	**190**	320	104	3	289	228	306	272	249	204
C3138-XL	33,3	**190**	320	104	3	289	228	306	272	249	204
C4138-XL-K30-V	40,9	**190**	320	128	3	284	222	306	–	255	204
C4138-XL-V	39,8	**190**	320	128	3	284	222	306	–	255	204
C2238-XL	35,3	**190**	340	92	4	296	224	323	275	250	207
C2238-XL-K	34,3	**190**	340	92	4	296	224	323	275	250	207
C3040-XL	22,2	**200**	310	82	2,1	285	235	299,8	272	252	210,2
C3040-XL-K	21,6	**200**	310	82	2,1	285	235	299,8	272	252	210,2
C4040-XL-K30-V	29,5	**200**	310	109	2,1	280	229	299,8	–	255	210,2
C4040-XL-V	28,7	**200**	310	109	2,1	280	229	299,8	–	255	210,2
C3140-XL-K	39,7	**200**	340	112	3	305	245	326	290	265	214
C3140-XL	40,9	**200**	340	112	3	305	245	326	290	265	214
C3044-XL-K	28,4	**220**	340	90	3	310	257	327,6	297	274	232,4
C3044-XL	29,2	**220**	340	90	3	310	257	327,6	297	274	232,4
C4044-XL-K30-V	38,3	**220**	340	118	3	306	251	327,6	–	280	232,4
C4044-XL-V	37,2	**220**	340	118	3	306	251	327,6	–	280	232,4
C3144-XL-K	49,8	**220**	370	120	4	333	268	353	316	291	237
C3144-XL	51,2	**220**	370	120	4	333	268	353	316	291	237
C2244-XL	58,2	**220**	400	108	4	350	259	383	323	292	237
C2244-XL-K	56,5	**220**	400	108	4	350	259	383	323	292	237

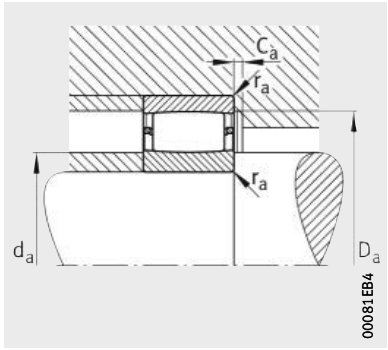
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



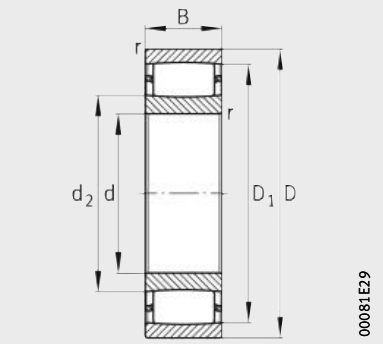
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
0,8	2	16,1	–	930	1 490	9,838	1,135	159	2 460	1 270
0,8	2	16,1	–	930	1 490	9,838	1,135	159	2 460	1 270
–	2	20	10,1	1 370	2 330	10,323	1,062	221	540	–
–	2	20	10,1	1 370	2 330	10,323	1,062	221	540	–
1,3	2,5	19	–	1 540	2 240	10,413	1,07	208	2 220	1 160
1,3	2,5	19	–	1 540	2 240	10,413	1,07	208	2 220	1 160
–	2,5	20	10,1	2 060	3 200	12,252	0,868	270	485	–
–	2,5	20	10,1	2 060	3 200	12,252	0,868	270	485	–
3	3	22,5	–	1 430	1 760	9,695	1,176	217	2 130	1 310
3	3	22,5	–	1 430	1 760	9,695	1,176	217	2 130	1 310
1,9	2	15,2	–	1 170	1 760	10,083	1,117	180	2 250	1 180
1,9	2	15,2	–	1 170	1 760	10,083	1,117	180	2 250	1 180
–	2	21	11,1	1 650	2 650	11,983	0,893	260	490	–
–	2	21	11,1	1 650	2 650	11,664	0,924	260	490	–
2,1	2,5	27,3	–	1 600	2 330	11,861	0,923	265	2 060	1 120
2,1	2,5	27,3	–	1 600	2 330	11,861	0,923	265	2 060	1 120
2	2,5	17,2	–	1 370	2 120	10,975	1,027	209	2 030	1 050
2	2,5	17,2	–	1 370	2 120	10,975	1,027	209	2 030	1 050
–	2,5	20	10,1	1 960	3 250	11,548	0,957	285	425	–
–	2,5	20	10,1	1 960	3 250	11,548	0,957	285	425	–
1,3	3	22,3	–	1 930	2 900	13,666	0,791	280	1 850	960
1,3	3	22,3	–	1 930	2 900	13,667	0,791	280	1 850	960
3,9	3	20,5	–	2 080	2 550	12,031	0,931	300	1 720	1 050
3,9	3	20,5	–	2 080	2 550	11,976	0,937	300	1 720	1 050

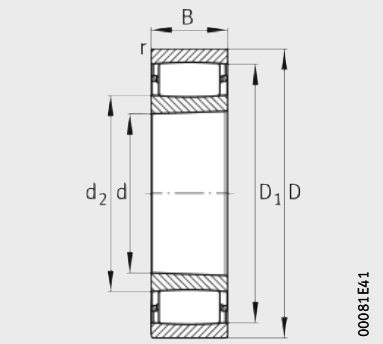
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

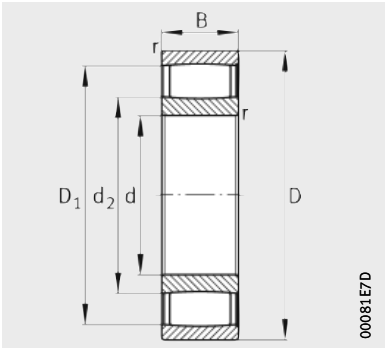


Tapered bore

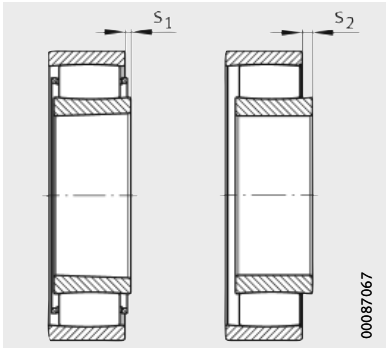
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C3048-XL-K	31,1	**240**	360	92	3	329	276	347,6	316	293	252,4
C3048-XL	32	**240**	360	92	3	329	276	347,6	316	293	252,4
C3148-XL-K	61,4	**240**	400	128	4	357	281	383	337	307	257
C3148-XL	63,2	**240**	400	128	4	357	281	383	337	307	257
C3052-XL-K	45	**260**	400	104	4	367	305	385,4	351	326	274,6
C3052-XL	46,4	**260**	400	104	4	367	305	385,4	351	326	274,6
C3152-XL-K	85,1	**260**	440	144	4	394	314	423	377	346	277
C3152-XL	87,5	**260**	440	144	4	394	314	423	377	346	277
C3056-XL-K	48,7	**280**	420	106	4	389	328	405,4	374	348	294,6
C3056-XL	50,1	**280**	420	106	4	389	328	405,4	374	348	294,6
C3156-XL	93,8	**280**	460	146	5	416	336	440	394	364	300
C3156-XL-K	91,2	**280**	460	146	5	416	336	440	394	364	300
C3060-XL-K-M	67,3	**300**	460	118	4	417	352	445,4	413	365	314,6
C3060-XL-M	69,2	**300**	460	118	4	417	352	445,4	413	365	314,6
C4060-XL-K30-M	93,9	**300**	460	160	4	410	338	445,4	409	351	314,6
C4060-XL-M	91,2	**300**	460	160	4	410	338	445,4	409	351	314,6
C3160-XL-K	120	**300**	500	160	5	448	362	480	426	391	320
C3160-XL	124	**300**	500	160	5	448	362	480	426	391	320
C3064-XL-M	74,7	**320**	480	121	4	440	376	465,4	437	389	334,6
C3064-XL-K-M	72,6	**320**	480	121	4	440	376	465,4	437	389	334,6
C3164-XL-M	161	**320**	540	176	5	476	372	520	470	393	340
C3164-XL-K-M	156	**320**	540	176	5	476	372	520	470	393	340

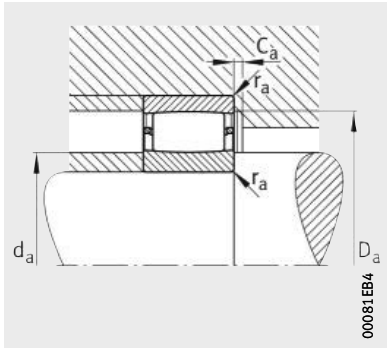
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



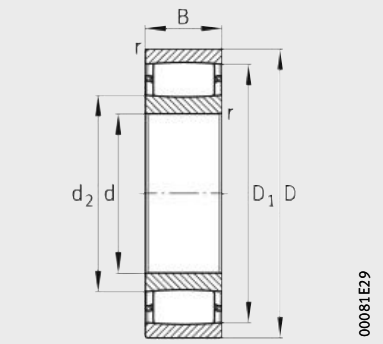
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
1,9	2,5	19,2	–	1 400	2 230	12,016	0,931	226	1 880	980
1,9	2,5	19,2	–	1 400	2 230	12,016	0,931	226	1 880	980
2,9	3	20,4	–	2 380	3 500	14,559	0,741	370	1 690	870
2,9	3	20,4	–	2 380	3 500	14,559	0,741	370	1 690	870
2,3	3	19,3	–	1 830	2 950	12,382	0,924	330	1 650	830
2,3	3	19,3	–	1 830	2 950	12,382	0,924	330	1 650	830
1,7	3	26,4	–	2 750	4 250	16,223	0,667	435	1 480	740
1,7	3	26,4	–	2 750	4 250	16,223	0,667	435	1 480	740
2,2	3	21,3	–	1 870	3 100	12,578	0,924	340	1 530	770
2,2	3	21,3	–	1 870	3 100	12,578	0,924	340	1 530	770
1,7	4	28,4	–	2 850	4 500	16,458	0,663	455	1 400	700
1,7	4	28,4	–	2 850	4 500	16,458	0,663	455	1 400	700
1,3	3	20	–	2 220	3 800	14,109	0,812	380	1 400	690
1,3	3	20	–	2 220	3 800	14,109	0,812	380	1 400	690
0,9	3	30,4	–	2 900	4 950	16,429	0,663	455	1 430	570
0,9	3	30,4	–	2 900	4 950	16,429	0,663	455	1 430	570
1,8	4	30,5	–	3 350	5 300	16,713	0,662	510	1 280	630
1,8	4	30,5	–	3 350	5 300	16,713	0,662	510	1 280	630
1,3	3	23,3	–	2 300	4 100	15,05	0,76	410	1 310	640
1,3	3	23,3	–	2 300	4 100	15,05	0,76	410	1 310	640
4	4	26,7	–	4 150	6 300	19,823	0,542	610	1 180	590
4	4	26,7	–	4 150	6 300	19,823	0,542	610	1 180	590

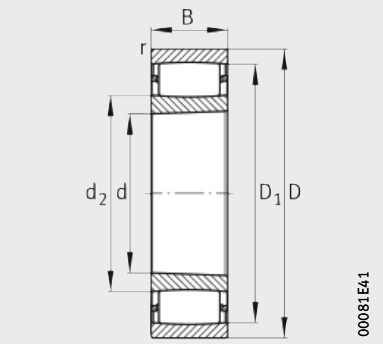
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

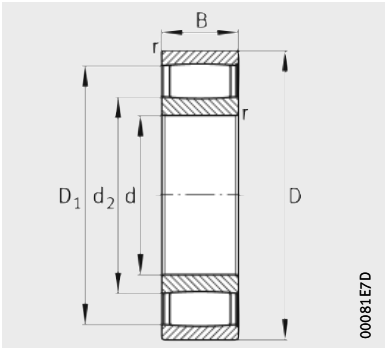


Tapered bore

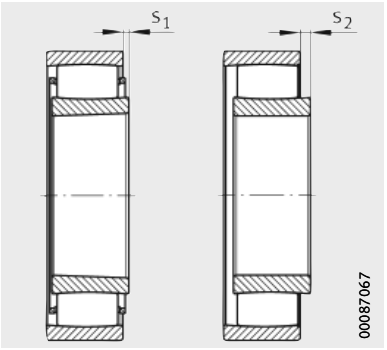
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C3068-XL-M	99,3	**340**	520	133	5	482	402	502	477	419	358
C3068-XL-K-M	96,5	**340**	520	133	5	482	402	502	477	419	358
C3168-XL-M	202	**340**	580	190	5	517	405	560	507	430	360
C3168-XL-K-M	197	**340**	580	190	5	517	405	560	507	430	360
C3072-XL-M	105	**360**	540	134	5	497	417	522	492	434	378
C3072-XL-K-M	102	**360**	540	134	5	497	417	522	492	434	378
C3172-XL-M	213	**360**	600	192	5	537	423	580	526	449	380
C3172-XL-K-M	207	**360**	600	192	5	537	423	580	526	449	380
C3076-XL-M	110	**380**	560	135	5	511	431	542	506	448	398
C3076-XL-K-M	107	**380**	560	135	5	511	431	542	506	448	398
C3176-XL-M	225	**380**	620	194	5	551	446	600	545	468	400
C3176-XL-K-M	218	**380**	620	194	5	551	446	600	545	468	400
C3080-XL-M	143	**400**	600	148	5	554	457	582	546	478	418
C3080-XL-K-M	139	**400**	600	148	5	554	457	582	546	478	418
C3180-XL-M	253	**400**	650	200	6	589	488	624	585	508	426
C3180-XL-K-M	246	**400**	650	200	6	589	488	624	585	508	426
C3084-XL-M	151	**420**	620	150	5	570	475	602	563	495	438
C3084-XL-K-M	146	**420**	620	150	5	570	475	602	563	495	438
C3184-XL-M	339	**420**	700	224	6	618	508	674	609	532	446
C3184-XL-K-M	329	**420**	700	224	6	618	508	674	609	532	446
C3092-XL-M	197	**460**	680	163	6	624	539	657	622	554	483
C3092-XL-K-M	192	**460**	680	163	6	624	539	657	622	554	483
C3192-XL-M	424	**460**	760	240	7,5	679	559	728	665	588	492
C3192-XL-K-M	412	**460**	760	240	7,5	679	559	728	665	588	492
C3096-XL-M	207	**480**	700	165	6	640	555	677	638	570	503
C3096-XL-K-M	201	**480**	700	165	6	640	555	677	638	570	503

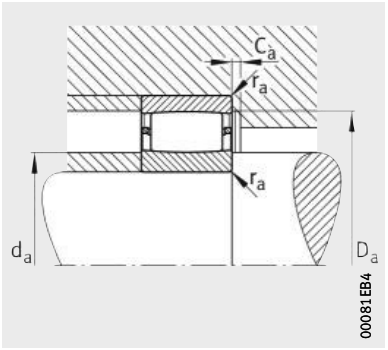
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



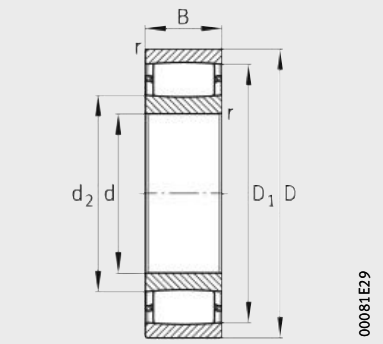
Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
3	4	25,4	–	2 950	4 950	15,578	0,745	490	1 170	560
3	4	25,4	–	2 950	4 950	15,578	0,745	490	1 170	560
2,7	4	25,9	–	4 900	7 500	22,16	0,481	710	1 060	510
2,7	4	25,9	–	4 900	7 500	22,16	0,481	710	1 060	510
3	4	26,4	–	2 950	5 000	15,709	0,745	490	1 120	550
3	4	26,4	–	2 950	5 000	15,709	0,745	490	1 120	550
2,7	4	27,9	–	5 100	8 000	22,058	0,489	750	1 020	485
2,7	4	27,9	–	5 100	8 000	22,058	0,489	750	1 020	485
3	4	27	–	3 050	5 200	15,827	0,745	500	1 090	530
3	4	27	–	3 050	5 200	15,827	0,745	500	1 090	530
2,1	4	25,4	–	5 000	8 500	20,403	0,544	720	990	455
2,1	4	25,4	–	5 000	8 500	20,403	0,544	720	990	455
3,7	4	30,6	–	3 750	6 200	17,354	0,675	600	980	475
3,7	4	30,6	–	3 750	6 200	17,354	0,675	600	980	475
1,8	5	50,7	–	4 800	8 300	20,809	0,542	750	910	435
1,8	5	50,7	–	4 800	8 300	20,809	0,542	750	910	435
3,6	4	32,6	–	3 800	6 400	19,149	0,599	640	950	460
3,6	4	32,6	–	3 800	6 400	19,141	0,599	640	950	460
1,9	5	34,8	–	6 000	10 600	24,992	0,435	890	860	390
1,9	5	34,8	–	6 000	10 600	24,992	0,435	890	860	390
1,6	5	33,5	–	4 000	7 700	18,223	0,664	660	850	395
1,6	5	33,5	–	4 000	7 700	18,223	0,664	660	850	395
2,1	6	51	–	6 800	12 000	25,204	0,441	1 010	760	350
2,1	6	51	–	6 800	12 000	25,204	0,441	1 010	760	350
1,6	5	35,5	–	4 050	7 800	18,226	0,671	710	820	390
1,6	5	35,5	–	4 050	7 800	21,856	0,525	710	820	390

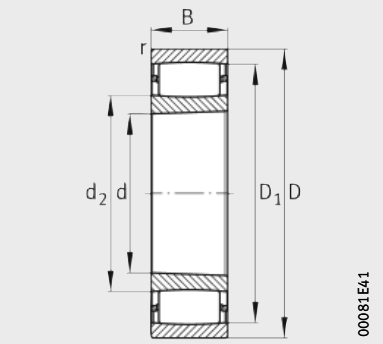
Toroidal roller bearings

Cylindrical or tapered bore
Full complement

X-life



Cylindrical bore

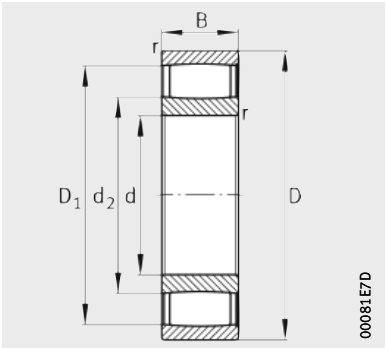


Tapered bore

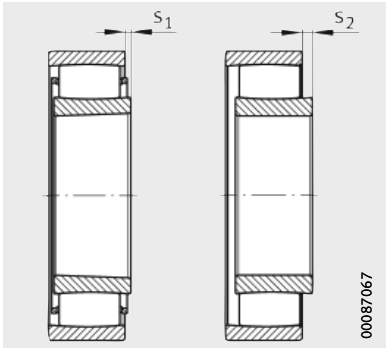
Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions						Mounting dimensions			
	m	d	D	B	r	D_1 ≈	d_2 ≈	D_a		d_a	
	≈ kg				min.			max.	min.	max.	min.
C30/500-XL-M	216	**500**	720	167	6	656	572	697	654	587	523
C30/500-XL-K-M	210	**500**	720	167	6	656	572	697	654	587	523
C31/500-XL-K-M	543	**500**	830	264	7,5	738	605	798	729	633	532
C31/500-XL-M	559	**500**	830	264	7,5	738	605	798	729	633	532
C30/530-XL-M	292	**530**	780	185	6	704	601	757	699	622	553
C30/530-XL-K-M	284	**530**	780	185	6	704	601	757	699	622	553
C31/530-XL-M	625	**530**	870	272	7,5	781	635	838	765	670	562
C31/530-XL-K-M	607	**530**	870	272	7,5	781	635	838	765	670	562
C30/560-XL-M	338	**560**	820	195	6	761	660	797	757	680	583
C30/560-XL-K-M	328	**560**	820	195	6	761	660	797	757	680	583
C30/600-XL-M	383	**600**	870	200	6	805	692	847	795	718	623
C30/600-XL-K-M	372	**600**	870	200	6	805	692	847	795	718	623
C30/630-XL-M	460	**630**	920	212	7,5	840	717	892	836	740	658
C30/630-XL-K-M	447	**630**	920	212	7,5	840	717	892	836	740	658
C30/670-XL-M	568	**670**	980	230	7,5	904	775	952	897	801	698
C30/670-XL-K-M	551	**670**	980	230	7,5	904	775	952	897	801	698
C30/710-XL-M	616	**710**	1 030	236	7,5	945	807	1 002	933	838	738
C30/710-XL-K-M	616	**710**	1 030	236	7,5	945	807	1 002	933	838	738
C40/710-XL-M	822	**710**	1 030	315	7,5	935	803	1 002	926	831	738
C40/710-XL-K30-M	846	**710**	1 030	315	7,5	935	803	1 002	926	831	738
C30/750-XL-K-M1B	733	**750**	1 090	250	7,5	993	858	1 062	965	905	778
C30/750-XL-M1B	755	**750**	1 090	250	7,5	993	858	1 062	965	905	778

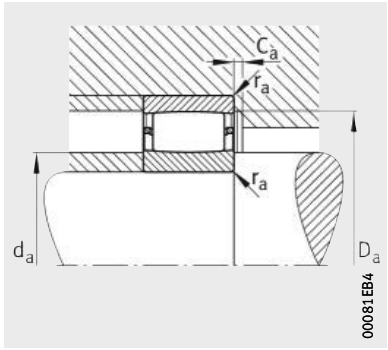
Before ordering, availability for delivery must be checked.



Full complement



Displacement distance



Mounting dimensions

				Basic load ratings		Calculation factors		Fatigue limit load	Limiting speed	Reference speed
C_a	r_a	s_1	s_2	dyn. C	stat. C_0	k_φ	k_δ	C_u	n_G	n_B
min.	max.			kN	kN			kN	min^{-1}	min^{-1}
1,5	5	37,5	–	4 250	8 500	18,515	0,664	720	800	365
1,5	5	37,5	–	4 250	8 500	18,515	0,664	720	800	365
4,4	6	75,3	–	7 500	12 900	25,64	0,441	1 090	680	330
4,4	6	75,3	–	7 500	12 900	25,64	0,441	1 090	680	330
2,3	5	35,7	–	5 200	9 700	21,626	0,548	840	730	340
2,3	5	35,7	–	5 200	9 700	21,626	0,548	840	730	340
3	6	44,4	–	9 100	16 100	30,734	0,356	1 310	640	280
3	6	44,4	–	9 100	16 100	30,734	0,356	1 310	640	280
1,9	5	45,7	–	5 600	11 000	22,38	0,54	920	660	300
1,9	5	45,7	–	5 600	11 000	22,38	0,54	920	660	300
2,5	5	35,9	–	6 300	12 200	28,196	0,403	1 060	620	275
2,5	5	35,9	–	6 300	12 200	28,196	0,403	1 060	620	275
4,6	6	48,1	–	6 900	12 900	29,154	0,39	1 150	580	270
4,6	6	48,1	–	6 900	12 900	29,154	0,39	1 150	580	270
2,8	6	41,1	–	8 300	16 500	27,179	0,44	1 300	530	226
2,8	6	41,1	–	8 300	16 500	27,179	0,44	1 300	530	226
5,1	6	47,3	–	9 000	17 600	27,729	0,435	1 400	500	214
5,1	6	47,3	–	9 000	17 600	27,729	0,435	1 400	500	214
1,3	6	51,2	–	10 600	22 200	34,788	0,321	1 550	510	169
1,3	6	51,2	–	10 600	22 200	34,788	0,321	1 550	510	169
2,8	6	25	–	9 500	19 400	28,466	0,428	1 350	475	200
2,8	6	25	–	9 500	19 400	28,466	0,428	1 350	475	200

Paper industry

In the dry section of a paper machine, the still damp paper web is fed over steam-heated rolls for final drying. The bearings in these dryer rolls run under high ambient temperatures in housings with recirculating oil lubrication, *Figure 1*.

Figure 1
Dryer roll in a paper machine

Requirements

The requirements placed on the bearing arrangement are:

- constraint-free compensation in the non-locating bearing of substantial changes in the axial length of the roll
- compensation of possible angular defects in the locating bearing and non-locating bearing
- resistance to substantial differences in temperature
- very high operational reliability of the bearing arrangement ($L_{hmn} > 100\,000$ h).

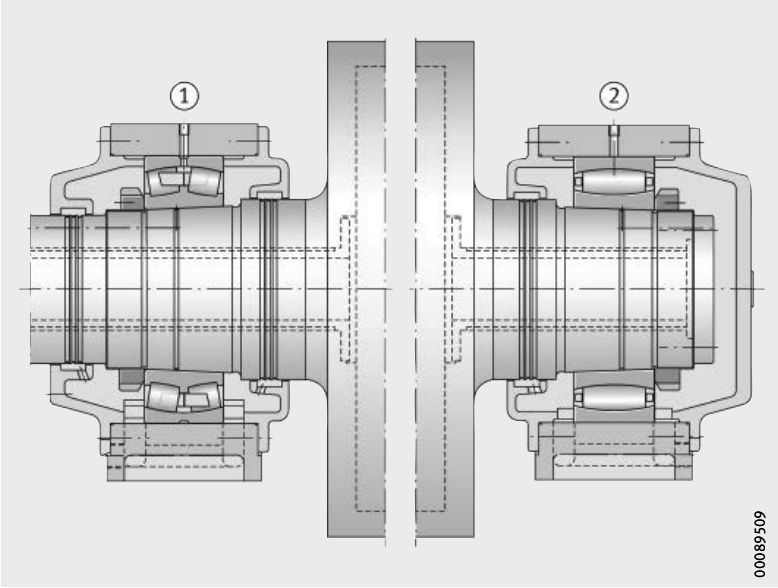
Design solution

The locating bearing side (drive side) is fitted with a spherical roller bearing, while the non-locating bearing arrangement is fitted with a toroidal roller bearing, *Figure 2*.

Both bearings are fully suitable for supporting any possible angular defects. Due to the robust design and load carrying capacity of these bearings, the required calculated rating life is achieved without difficulty, since the bearings are partially specified by the hollow journal of the roll.

The two bearing types have metal cages as are required in the paper industry. With the resulting bearing size, the toroidal roller bearing on the non-locating side is then capable of supporting axial thermal expansion of the roll of up to 15 mm. Due to this length compensation, almost no axial forces occur, which supports vibration-free running of the roll. Both bearing types are mounted directly on the tapered journals, ensuring high running accuracy. Axial location is carried out by means of a shaft nut HMZ.

Since very high heating temperatures sometimes occur during the heating phase, a radial internal clearance to Group 4 and case hardened inner rings (W209B) are normally used. With the characteristivcs described, the bearing combination shown is optimally suited to the requirements.



① Spherical roller bearing as locating bearing
② Toroidal roller bearing as non-locating bearing

Figure 2
Optimum bearing combination

Products used

- Toroidal roller bearing C31..-XL-K-W209B-C4 with bore code: 44, 48, 52, 56
- Spherical roller bearing 231..-BE-XL-K-W209B-C4 with bore code: 44, 48, 52, 56
- Shaft nut HM30 with bore code: 44, 48, 52, 56
- Shaft nut HMZ30 with bore code: 44, 48, 52, 56.

Steel industry

The operating conditions in continuous casting plant place very high requirements on the bearings used, *Figure 1*. The rolling bearings support high loads at low speeds; the bearings are exposed to high temperatures, spray water and contamination. An operating life of 1 year to 2 years is required.

Figure 1
Continuous casting plant

Requirements

The requirements placed on the design are:

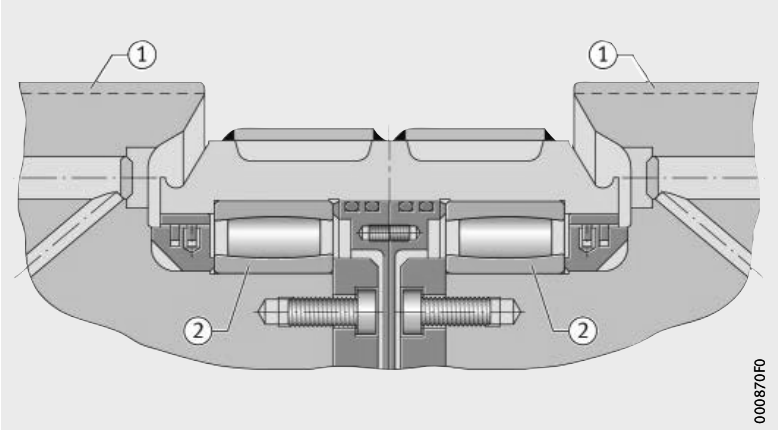
- high static load carrying capacity
- support of axial expansion of the shaft
- compensation of angular defects arising from shaft deflection.

Design solution

The strand guide rolls in the continuous casting plant are normally supported by means of a locating/non-locating bearing arrangement, *Figure 2*. The function of the non-locating bearings is to accommodate length expansion of the shaft as far as possible without constraint and to compensate for shaft deflection.

The toroidal roller bearing can effectively compensate changes in the length of the shaft due to the facility for displacement between the inner ring and outer ring. As a result of the internal geometry, angular defects arising from shaft deflection can be compensated.

Due to the full complement design in this application, the very high basic static load rating required can be achieved.



① Strand guide rolls
② Toroidal roller bearings

Figure 2
Bearing arrangement of strand guide rolls

Products used

- Toroidal roller bearing C40..-XL-V-C3 with bore code: 22, 24, 26, 28, 30, 32
- Toroidal roller bearing C40..-XL-V-C with bore code: 22, 24, 26, 28, 30, 32
- Toroidal roller bearing C41..-XL-V-C3 with bore code: 22, 24, 26, 28, 30, 32
- Toroidal roller bearing C41..-XL-V-C4 with bore code: 22, 24, 26, 28, 30, 32.

Ventilators

Ventilators are used in many branches of industry. In accordance with their function, they are described as fans or blowers, *Figure 1*. Depending on the direction of the air or gas flow, a distinction is made between radial and axial ventilators. They are used, for example, to improve the interior climate and aerate production buildings, tunnels and mines. In processes, they can accelerate combustion processes, start and maintain operation of process plant by means of gas mass flows or extract exhaust gases.

Figure 1
Ventilators

Requirements

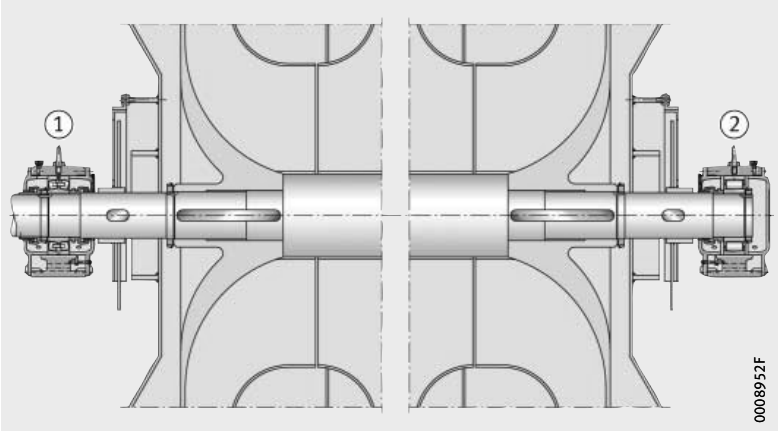
The rolling bearings in such machines are subject to operating conditions such as high speeds, different loads, skewing and vibrations. The media conveyed, such as heating gas, require constraint-free adjustment of the non-locating bearing during operation.

Design solution

Through the use of the toroidal roller bearing as a non-locating bearing, the axial shaft offset resulting from the dynamically variable axial thrust can be compensated without constraint, *Figure 2*.

Furthermore, this gives the following advantages:

- constraint-free compensation within the bearing of the shaft length – no risk of the “stick-slip effect” in the housing bore
- reduction in vibrations and noise
- lower operating temperature relative to the complete system even under unfavourable operating conditions
- longer grease operating life
- reduced sensitivity to unbalance due to the feasibility of a tight outer ring fit.



① Spherical roller bearing
② Toroidal roller bearing

Figure 2
Blower bearing arrangement

Products used

- Toroidal roller bearing C22..XL-K-C3 with bore code: 10 to 24
- Toroidal roller bearing C23..XL-K-C3 with bore code: 10 to 24
- Spherical roller bearing 222..-E1-K-C4 and adapter sleeve
- Spherical roller bearing 223..-E1-K-C4 and adapter sleeve.

Marine propulsion systems

For marine propulsion systems, a conceptual distinction is made between compact designs and conventional power trains. This results in differing requirements. Across the concepts, the non-locating bearing function can be fulfilled by toroidal roller bearings, *Figure 1* and *Figure 2*.

Figure 1
Compact drives with a 360° rotation facility fitted to the stern of a ship

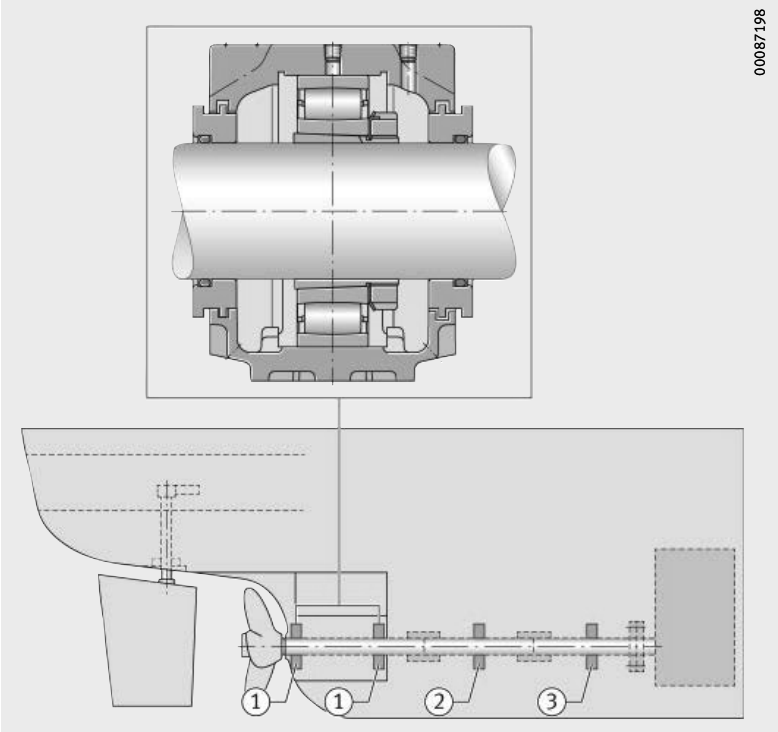
Figure 2
Rigid drive propeller at the end of a conventional drive train

Requirements

In the case of conventional drives, it is normally misalignment resulting from shaft offset and deflection that must be supported. In compact drives, such as POD drives, the challenge is associated with temperature-induced elongations. When used in a non-locating bearing solution, the significant advantages of the axial displacement capability of a cylindrical roller bearing and the angular adjustability of a spherical roller bearing can be combined.

Design solution

In conventional applications, the system solution results from the combination with spherical roller bearings for supporting axial loads. These are caused by the thrust of the propeller. Radial loads often occur as a result of structural shaft offsets, deflections in shaft segments in the drive train and the inherent mass, *Figure 3*.



① Toroidal roller bearing
② Radial spherical roller bearing
③ Axial spherical roller bearing

Figure 3
Cross-section of drive train

In nacelle drives, the toroidal roller bearing on the propeller side acts in combination with a thrust bearing unit, normally realised by means of two axial spherical roller bearings, *Figure 4*.

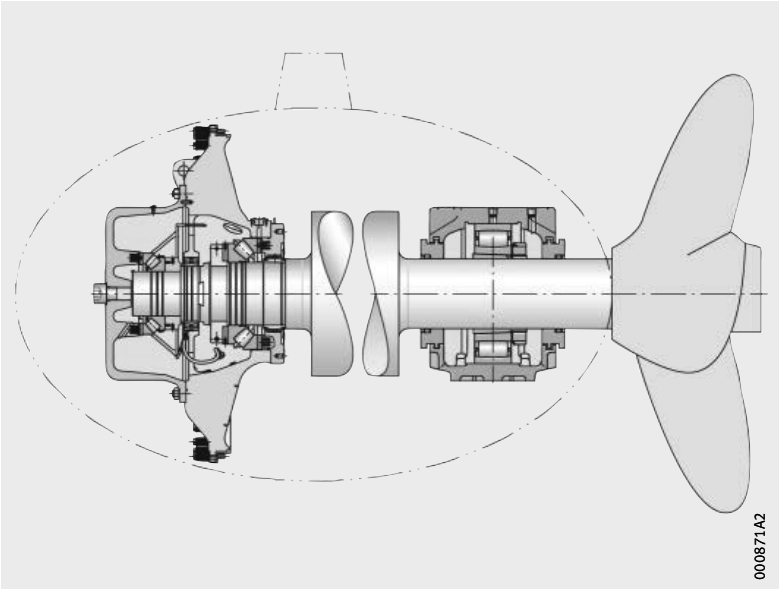


Figure 4
Cross-section of nacelle drive

Products used

- Toroidal roller bearing C30..-XL-K with bore code: 64, 84, 96 or alternatively 630 mm inner ring bore
- Radial spherical roller bearing 239..-B-K-MB with bore code: 76, 80, 88 or alternatively 630 mm inner ring bore
- Axial spherical roller bearing 294..-E1-XL with bore code: 84, 88 or alternatively 600 mm, or 630 mm inner ring bore.

Notes

Notes

Notes

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