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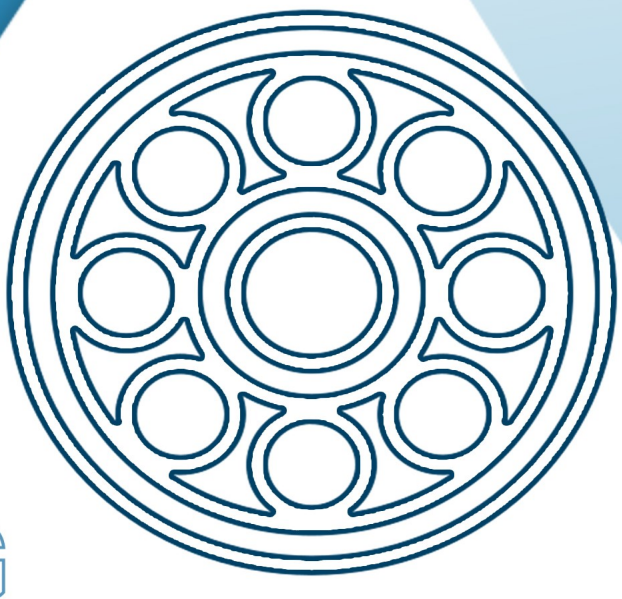


Catalog 2021

BULL BEARING

SCHAEFFLER

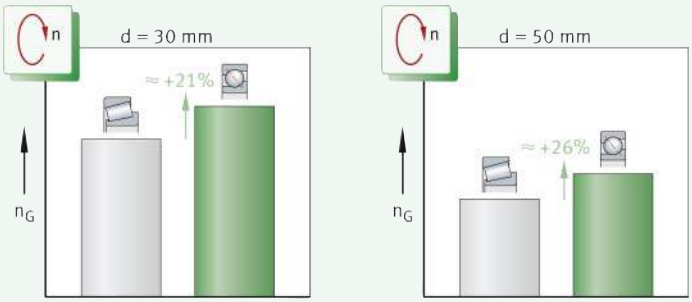
Ball bearing

1 Single row angular contact ball bearings

Single row angular contact ball bearings are particularly suitable where:

- bearing arrangements must support combined loads, i.e. radial and axial loads acting simultaneously ➤283|2
- moderate to high axial loads are present on one side
- rigid axial guidance is required
- the bearing arrangement must be axially clearance-free or preloaded
- high speeds are required under higher radial and axial loads
- the bearing arrangement is to run quietly in addition to meeting the requirements stated above.

For an overview of other product-specific features, see the Matrix for bearing preselection ➤280.



1 *Angular contact ball bearings: speed comparison with tapered roller bearings*

n_G = *limiting speed*

1.1 Bearing design

Design variants

The standard product range comprises bearings of series 718..-B, 70..-B(-2RS), 72..-B(-2RS), 73..-B(-2RS) and 74..-B.
These bearings are also available for various applications as:

- bearings of basic design for bearing arrangements with single bearings ➤283|2
- universal bearings for installation in sets in a tandem, O or X arrangement ➤284|3, ➤284|4, ➤285|5
- X-life bearings ➤285.

Single row angular contact ball bearings are also available in other dimension series, designs and sizes. Information on these bearings is available from Schaeffler on request. Larger catalogue bearings ➤ GL 1.

Bearings of basic design for bearing arrangements with single bearings

The forces are transmitted oblique to the radial plane

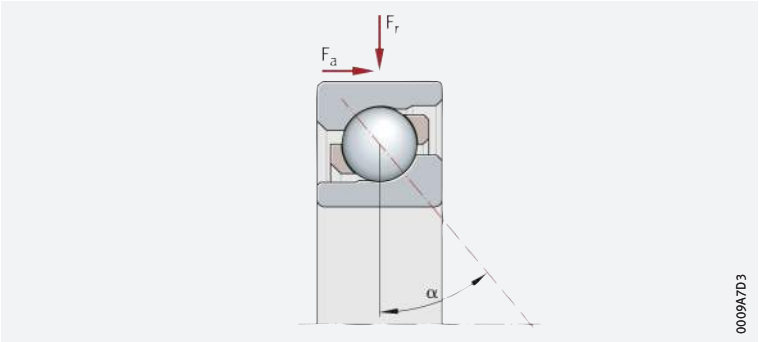
Single row angular contact ball bearings are part of the group of radial ball bearings. These self-retaining units have solid outer and inner rings. The rolling elements are guided by cages made from polyamide, sheet steel, or brass. The bearing rings are designed with one high shoulder and one low shoulder ➤*283*|🗀*2*. As a result of the different shoulder heights, the mounting method differs from that of deep groove ball bearings. The possible number of balls for angular contact ball bearings with identical dimensions is higher than for deep groove ball bearings. In contrast to deep groove ball bearings, the raceways on the inner and outer rings are arranged obliquely to each other in the direction of the bearing axis. As a result, the forces are transmitted from one raceway to the other at a defined contact angle (oblique to the radial plane) ➤*287*|🗀*7*.

For bearing positions with only one bearing each

These angular contact ball bearings can be considered when only one bearing is used per bearing position. As the bearings have standard bearing ring tolerances (they are manufactured to tolerance class Normal), they are not suitable for mounting directly adjacent to each other. In such cases, universal bearings should be used.

🗀*2*
Single row angular contact ball bearing of basic design

F_r = *radial load*
F_a = *axial load*
α = *nominal contact angle*



Universal bearings for mounting in sets

Bearings can be mounted in pairs in any arrangement required

Single row angular contact ball bearings, which are intended for mounting in pairs (in sets) directly adjacent to each other, are manufactured in the so-called universal design ➤*284*|🗀*3*, ➤*284*|🗀*4*, ➤*285*|🗀*5*. These bearings can be used in pairs in any arrangement without shims. Depending on the design selected, the mounted bearing pair has the required axial clearance, freedom from clearance or preload. This gives easier design of the bearing arrangement and mounting of the bearings.

When ordering, please state the number of bearings, not the number of bearing pairs.

Suffixes: UA, UB, UO, UL, UM, UH

Bearings of a universal design are indicated by the suffix UA, UB, UO, UL, UM or UH ➤*293*|▦*6*. If bearings of the universal design are arranged in sets, this gives a defined axial clearance or an axial preload:

- UA = bearing set with small axial internal clearance
- UB = bearing set with smaller axial internal clearance than UA
- UO = bearing set clearance-free in O or X arrangement
- UL = bearing set with light preload
- UM = bearing set with moderate preload
- UH = bearing set with high preload.

✎ *Reasons for mounting in sets*

Single row angular contact ball bearings are mounted in sets if:

- the load carrying capacity of one bearing is not sufficient (bearing set in a tandem arrangement)
- combined or axial loads occur in both directions and the bearing arrangement must have a defined axial clearance (bearing set in O or X arrangement).

The following arrangements are possible for mounting in sets:

- tandem arrangement ➤*284*|*3*
- O arrangement ➤*284*|*4*
- X arrangement ➤*285*|*5*.

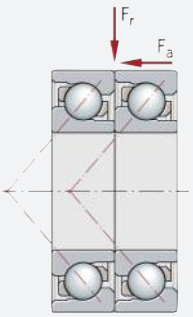
Bearing sets in tandem arrangement

✎ *Tandem arrangement*

In a tandem arrangement, the contact lines run parallel to each other ➤*284*|*3*. Axial forces are distributed equally over both bearings, but can only be supported by the bearing set from one direction. In order to support axial forces from the opposing direction, as well as combined loads, the bearing set is always adjusted against a further bearing.

3
Universal bearings, mounted in set in a tandem arrangement

Bearing set in tandem arrangement



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Bearing sets in O arrangement

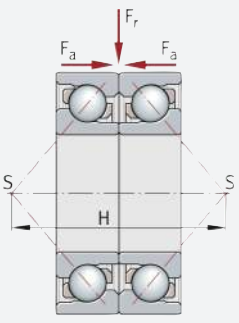
✎ *O arrangement*

In an O arrangement, the apexes of the cones formed by the contact lines point outwards, i.e. they diverge relative to the bearing axis ➤*284*|*4*. Bearing sets in an O arrangement support axial forces from both directions, but only ever with one bearing. Due to the large support spacing (i.e. the spacing between the contact cone apexes), these give relatively rigid bearing arrangements (small tilting clearance) and are also suitable for supporting tilting moments.

4
Universal bearings, mounted in set in an O arrangement

Bearing set in O arrangement

S = *contact cone apex*
H = *support spacing*



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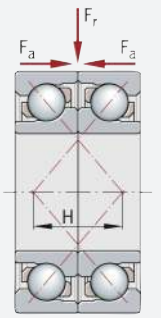
Bearing sets in X arrangement

X arrangement

In an X arrangement, the apexes of the cones formed by the contact lines point inwards, i.e. they converge relative to the bearing axis ➤*285*|*5*. Once again, bearing sets of this type support axial forces from both directions, but also only ever with one bearing. The support base is, however, smaller than in an O arrangement. As a result, the sets are not as rigid as in an O arrangement. Furthermore, they are less suitable for supporting tilting moments.

5
Universal bearings, mounted in set in an X arrangement



Bearing set in X arrangement

H = *support spacing*

X-life premium quality

Many sizes in series 70..-B, 72..-B, 73..-B and 74..-B are available as X-life bearings ➤*304*|▦. These bearings exhibit considerably higher performance than standard single row angular contact ball bearings ➤*286*|*6*. This is achieved, for example, through the modified internal construction, higher surface quality of the contact surfaces and optimised cage design, as well as through the improved quality of the steel and rolling elements.

Advantages

Increased customer benefits due to X-life

The technical enhancements offer a range of advantages, such as:

- a more favourable load distribution in the bearing and thus a higher dynamic load carrying capacity of the bearings ➤*286*|*6*
- quieter running
- running with reduced friction and greater energy efficiency
- lower heat generation in the bearing
- higher possible speeds
- lower lubricant consumption and, consequently, longer maintenance intervals
- a measurably longer operating life of the bearings
- high operational security
- compact, environmentally-friendly bearing arrangements.

Lower operating costs, higher machine availability

In conclusion, these advantages improve the overall cost-efficiency of the bearing position significantly and thus bring about a sustainable increase in the efficiency of the machine and equipment.

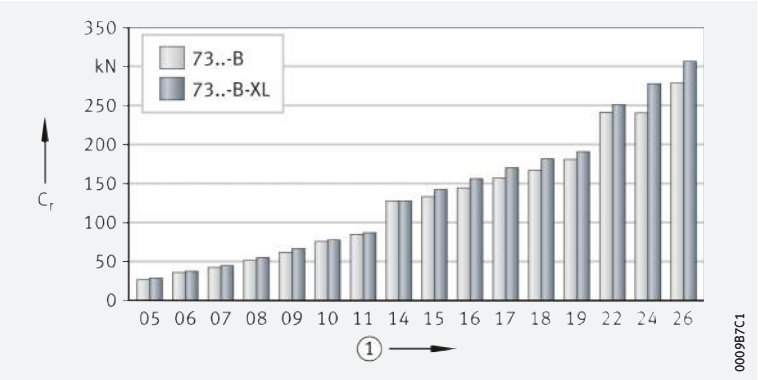
✎ *Suffix XL*

Single row X-life angular contact ball bearings include the suffix XL in the designation ➤*293*|🗗 *9*, ➤*294*|🗗 *10* and ➤*304*|▦.

🗗**6**
Comparison of basic dynamic load rating C_r – bearing series 73..-B-XL, bore code 05 to 26, with a bearing which is not of X-life quality (73..-B)

C_r = *basic dynamic load rating*

① *Bore code*



Areas of application

✎ *Wide application range*

Due to their special technical features, single row X-life angular contact ball bearings are highly suitable for bearing arrangements in:

- compressors
- fluid and hydraulic pumps
- automotive chassis and gearboxes
- industrial gearboxes
- electric motors
- industrial ventilators
- machine tools
- textile machinery.

X-life indicates a high product performance density and thus a particularly significant benefit to the customer. Further information on X-life ➤*10*.

1.2 Load carrying capacity

✎ *Radial load*

Single row angular contact ball bearings can support high radial forces. Pure radial loads are also possible, if the bearings are adjusted.

✎ *Axial loading is only possible on one side*

Due to the geometry and position of the raceway shoulders, axial loads are only transmitted from one direction ➤*283*|🗗 *2*. If these angular contact ball bearings are required to support axial forces from both directions, they are adjusted against a second bearing in a mirror image arrangement ➤*295*|🗗 *11* and ➤*295*|🗗 *12*.

✎ *The axial load carrying capacity of the bearings increases with the size of the contact angle*

The contact angle α is the angle encompassed by the contact line and the radial plane, under which the load is transmitted from one raceway to the other ➤*287*|🗗 *7*. The axial load carrying capacity of the bearing increases with the value of α, i. e. the greater the angle, the higher the axial load to which the bearing can be subjected. As a result, angular contact ball bearings are more suitable than deep groove ball bearings for supporting higher axial forces. Due to the nominal contact angle of $\alpha = 40°$, single row angular contact ball bearings can support high axial loads on one side.

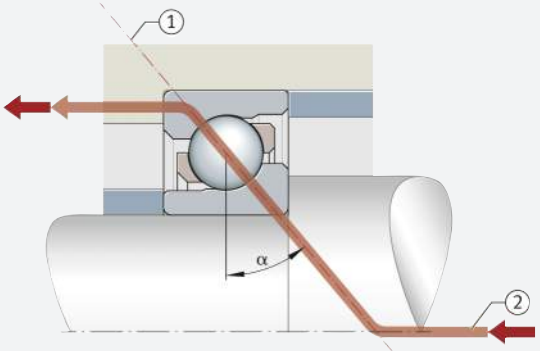
For information on angular contact ball bearings available with contact angles other than $\alpha = 40°$, please consult Schaeffler.

7
Contact angle and force flow

α = *contact angle*

① *Contact line*

② *Force flow*



Load carrying capacity of bearing sets

The basic dynamic and static load ratings C_r and C_{0r} in the product tables always refer to the single bearing. If two bearings of the same size and design are arranged immediately adjacent to each other in an O or X arrangement, the following will apply to the bearing pairs:

- $C_r = 1{,}625 \cdot C_{r\ \text{single bearing}}$
- $C_{0r} = 2 \cdot C_{0r\ \text{single bearing}}$

1.3 Compensation of angular misalignments

The angular adjustment facility of the bearings is very limited

Single row angular contact ball bearings are not suitable for the compensation of angular misalignments. In addition, misalignments induce internal forces in the bearing, which not only lead to higher temperatures, but also to a reduction in the bearing rating life.

Angular contact ball bearings arranged in sets

Misalignments in angular contact ball bearings mounted in sets lead – particularly with a small internal clearance and an O arrangement – to increased loads on the balls and cage, as the angular misalignments are supported under constraint between the balls and raceways. This can, in turn, have a negative effect on the operating life of the bearings. In addition, it should be noted that running noise is increased by a misalignment of the bearing rings.

1.4 Lubrication

Greased bearings are maintenance-free

Angular contact ball bearings sealed on both sides are greased with a high quality grease and do not require relubrication.

Ungreased bearings must be lubricated

Open bearings and bearings with seals on one side are not greased. These bearings must be lubricated with oil or grease.

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.

1.5 Sealing

Sealing with contact seals 2RS

Bearings with the suffix 2RS have lip seals on both sides ➤*293*|▦*6*. Due to their good sealing action, they are suitable for use in dusty, contaminated or damp environments.

Open bearings

In the case of unsealed bearings, sealing of the bearing position must be carried out by the adjacent construction. The sealing system should reliably prevent:

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

1.6 Speeds

Limiting speeds and reference speeds in the product tables

Two speeds are generally indicated in the product tables ➤*304*|▦:

- the kinematic limiting speed n_G
- the thermal speed rating $n_{\vartheta r}$.

Limiting speeds

The limiting speed n_G is the kinematically permissible speed of the bearing. Even under favourable mounting and operating conditions, this value should not be exceeded without prior consultation with Schaeffler ➤*64*.

The values given in the product tables are valid for oil lubrication in the case of bearings without seals or shields and for grease lubrication where bearings are supplied greased and with seals or shields.

Values for grease lubrication

For grease lubrication, 75% of the value stated in the product tables is permissible in each case.

Reference speeds

$n_{\vartheta r}$ is used to calculate n_ϑ

The thermal speed rating $n_{\vartheta r}$ is not an application-oriented speed limit, but is a calculated ancillary value for determining the thermally safe operating speed n_ϑ ➤*64*.

Bearings with contact seals

For bearings with contact seals, no reference speeds are defined in accordance with DIN ISO 15312:2004. As a result, only the limiting speed n_G is given in the product tables for these bearings.

Bearing sets of universal design

Bearing pairs usually operate at lower speeds than single bearings

Angular contact ball bearings of universal design can be used in an X, O or tandem arrangement ➤*284*|⧉*3* to ➤*285*|⧉*5*. The thermally safe operating speed of the bearing pair is then approximately 20% below the calculated permissible operating speed of the single bearing.

1.7 Noise

The Schaeffler Noise Index (SGI) has been developed as a new feature for comparing the noise level of different bearing types and series. As a result, a noise evaluation of rolling bearings can now be carried out for the first time.

Schaeffler Noise Index

The SGI value is based on the maximum permissible noise level of a bearing in accordance with internal standards, which is calculated on the basis of ISO 15242. In order that different bearing types and series can be compared, the SGI value is plotted against the basic static load rating C_0.

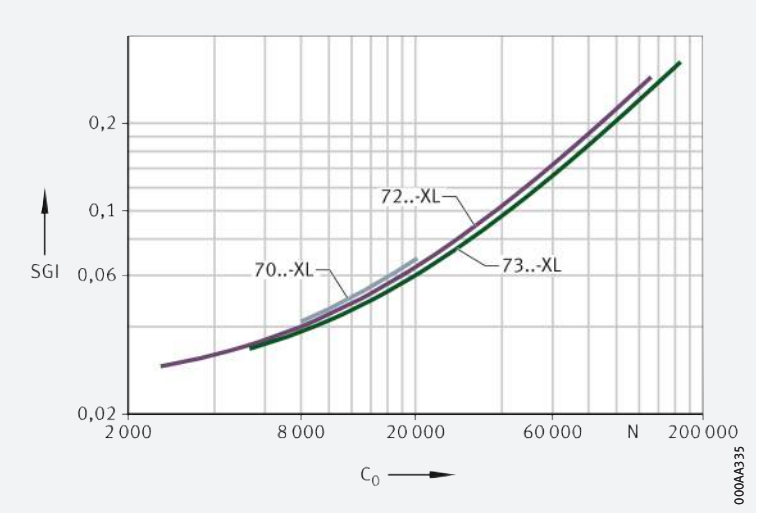
This permits direct comparisons between bearings with the same load carrying capacity. The upper limit value is given in each of the diagrams. This means that the average noise level of the bearings is lower than illustrated in the diagram.

The Schaeffler Noise Index is an additional performance characteristic in the selection of bearings for noise-sensitive applications. The specific suitability of a bearing for an application in terms of installation space, load carrying capacity or speed limit for example, must be checked independently of this.

The Noise Index is currently available for the main series. Additional series will be updated and introduced in subsequent publications.

Further information:

- ***medias*** ➤ *https://medias.schaeffler.com*.



8
Schaeffler Noise Index for single row angular contact ball bearings

SGI = *Schaeffler Noise Index*
C_0 = *basic static load rating*

1.8 Temperature range

Limiting values

The operating temperature of the bearings is limited by:

- the dimensional stability of the bearing rings and rolling elements
- the cage
- the lubricant
- the seals.

Possible operating temperatures of single row angular contact ball bearings ➤*290*|▦*1*.

▦**1**
Permissible temperature ranges

Operating temperature	Single row angular contact ball bearings, open		Single row angular contact ball bearings, sealed
	with sheet steel or brass cage	with polyamide cage PA66	
	–30 °C to +150 °C, for D > 240 mm up to +200 °C	–30 °C to +120 °C	–30 °C to +110 °C, limited by the lubricant and seal material

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

1.9 Cages

Solid cages made from brass and PA66, as well as sheet steel cages, are used as standard

Standard cages and additional cage designs for single row angular contact ball bearings are made from brass, polyamide or steel ➤*290*|▦*2*. 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 brass or sheet steel cages should be used. If there is any uncertainty regarding cage suitability, please consult Schaeffler.

▦**2**
Cage, cage suffix, bore code

Bearing series	Solid cage made from polyamide PA66 TVH, TVP		Solid brass cage MP		Sheet steel cage JP
	standard	also available for	standard	also available for	also available for
	Bore code				
718	06 to 16	–	–	–	–
70	04 to 08	–	–	–	–
72	up to 20, 22 to 26	–	21, from 28	00, 03, from 05	up to 20, 22
73	up to 20, 22 to 26	–	21, from 28	from 04	up to 20, 22
74	–	07 to 15	05 to 16	–	07 to 15

1.10 Internal clearance

Axial internal clearance, preload and preload force of bearing sets with universal bearings in O or X arrangement

Valid for bearing sets in O or X arrangement

Values for axial internal clearance, preload and preload force of bearings of universal design ➤*291*|▦*3*. The values for axial internal clearance are valid for unmounted bearing sets in an O or X arrangement, which are free from load and measurement forces (without elastic deformation).

The angular contact ball bearings can also be supplied with a different internal clearance. Please consult Schaeffler in this case.

▦*3*

Axial internal clearance, preload and preload force of bearing sets with universal bearings in O or X arrangement for tolerance classes Normal, 6, 5

UA = *bearing with small axial internal clearance*
UB = *bearing with smaller axial internal clearance than UA*
UO = *bearing clearance-free in O or X arrangement*
UL = *bearing with light preload*

Bore code	Axial internal clearance or preload of bearing pair Nominal dimension µm							Preload force $F_{V\,max}$ N			
	UA	UB	UO	UL				UL			
	Bearing series										
	70..-B, 72..-B, 73..-B, 74..-B			70..-B	72..-B	73..-B	74..-B	70..-B	72..-B	73..-B	74..-B
00	22	14	0	–	–3	–	–	–	38	–	–
01	24	15	0	–	–4	–5	–	–	53	82	–
02	24	15	0	–	–4	–5	–	–	62	99	–
03	24	15	0	–	–4	–6	–	–	77	123	–
04	28	16	0	–4	–5	–6	–8	103	103	146	258
05	34	19	0	–4	–4	–6	–8	115	112	200	300
06	34	19	0	–5	–5	–7	–8	141	157	250	365
07	40	22	0	–5	–6	–7	–9	172	208	300	462
08	40	22	0	–5	–6	–8	–10	200	246	385	535
09	44	24	0	–	–6	–9	–10	–	277	462	600
10	44	24	0	–	–6	–10	–10	–	288	535	692
11	46	25	0	–	–7	–10	–11	–	358	600	785
12	46	25	0	–	–7	–10	–11	–	431	692	877
13	46	25	0	–	–8	–11	–12	–	492	785	977
14	50	27	0	–	–8	–11	–12	–	535	877	1 154
15	50	27	0	–	–8	–12	–13	–	523	977	1 154
16	50	27	0	–	–8	–12	–16	–	615	1 077	1 385
17	54	31	0	–	–8	–13	–	–	692	1 154	–
18	54	31	0	–	–9	–13	–	–	815	1 231	–
19	54	31	0	–	–10	–14	–	–	892	1 331	–
20	54	31	0	–	–11	–14	–	–	992	1 485	–
21	58	34	0	–	–11	–14	–	–	1 100	1 538	–
22	58	34	0	–	–12	–15	–	–	1 177	1 723	–
24	58	34	0	–	–12	–16	–	–	1 277	1 923	–
26	60	34	0	–	–12	–17	–	–	1 431	2 115	–
28	60	34	0	–	–12	–17	–	–	1 508	2 308	–
30	60	34	0	–	–13	–18	–	–	1 723	2 500	–
32	60	34	0	–	–13	–18	–	–	1 815	2 769	–
34	70	40	0	–	–14	–19	–	–	2 038	3 115	–

Tolerances for axial internal clearance and preload

Tolerances for axial internal clearance and preload of bearing sets with universal bearings in O and X arrangement ➤*292*|▦*4*.

▦4
Tolerances for axial internal clearance and preload of bearing sets with universal bearings in O or X arrangement

Bore code	Tolerances µm					
	Bearing series					
	70..-B, 72..-B		73..-B		74..-B	
	Tolerance class					
	Normal, 6	5	Normal, 6	5	Normal, 6	5
00 to 07	+8 0	+6 0	+8 0	+6 0	+8 0	+6 0
08 to 09	+8 0	+6 0	+8 0	+6 0	+12 0	+10 0
10 to 11	+8 0	+6 0	+12 0	+10 0	+12 0	+10 0
12 to 34	+12 0	+10 0	+12 0	+10 0	+12 0	+10 0

1.11 Dimensions, tolerances

Dimension standards

The main dimensions of angular contact ball bearings of the basic design correspond to DIN 628-1:2008 and ISO 12044:2014. Nominal dimensions of angular contact ball bearings ➤*304*|▦.

Chamfer dimensions

The limiting dimensions for chamfer dimensions correspond to DIN 620-6:2004. Overview and limiting values ➤*135*|*7.11*. Nominal value of chamfer dimension ➤*304*|▦.

Tolerances

The tolerances for the dimensional and running accuracy of single row angular contact ball bearings correspond to tolerance class Normal in accordance with ISO 492:2014. Tolerance values in accordance with ISO 492 ➤*122*|▦*8*.

Tolerances for bearings of universal design

✎*Single row bearings are also available in tolerance class 5*

In addition to the tolerance class Normal (no tolerance suffix), angular contact ball bearings of universal designs UA, UB, UO and UL are also available by agreement in tolerance class 5 and, in some cases, in tolerance class 6. Tolerance values in accordance with ISO 492 ➤*122*|▦*8* to ➤*127*|▦*16*. The tolerance suffix for bearings of universal design in tolerance class 5 is then:

- P5-UA, P5-UB, P5-UO, P5-UL.

The bores of bearings of universal design for all tolerance classes are uniformly toleranced to tolerance class 5 (no special suffix). The bearing width for universal bearings is toleranced to ISO 492:2014. For width tolerances ➤*292*|▦*5*.

▦5
Tolerance for ring width in bearings of universal design

Tolerance symbols ➤*122*|▦
U = *upper limit deviation*
L = *lower limit deviation*

Nominal bore diameter d mm		Width deviation $t_{\Delta Bs}$ µm			
		Bearings in tolerance class			
		Normal, 6		5	
over	incl.	U	L	U	L
–	50	0	−250	0	−250
50	80	0	−380	0	−250
80	120	0	−380	0	−380
120	180	0	−500	0	−380
180	315	0	−500	0	−500

1.12 Suffixes

For a description of the suffixes used in this chapter ➤*293*|▦*6* and ***medias*** interchange ➤*https://www.schaeffler.de/std/1D52*.

▦*6*
Suffixes and corresponding descriptions

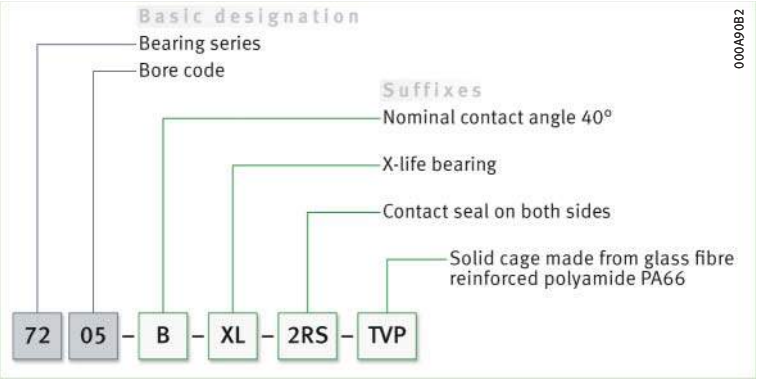
Suffix	Description of suffix	
B	Modified internal construction, nominal contact angle $\alpha = 40°$	Standard
JP	Sheet steel cage	Standard, dependent on bore code
MP	Solid brass cage	
TVH, TVP	Solid cage made from glass fibre reinforced polyamide PA66	
P5	Bearing in tolerance class 5	Special design, available by agreement
2RS	Contact seal on both sides (lip seal)	Standard
UA	Universal design for fitting in pairs, bearing pair has a small axial internal clearance in O and X arrangement	
UB	Universal design for fitting in pairs, bearing pair has a smaller axial internal clearance in O and X arrangement than in UA	
UH	Universal design for fitting in pairs, bearing pair has a high preload in O and X arrangement	Available by agreement
UL	Universal design for fitting in pairs, bearing pair has a light preload in O and X arrangement	Standard
UM	Universal design for fitting in pairs, bearing pair has a moderate preload in O and X arrangement	Available by agreement
UO	Universal design for fitting in pairs, bearing pair is clearance-free in O and X arrangement	Standard
XL	X-life bearing, dependent on bore code and bearing type	Standard

1.13 Structure of bearing designation

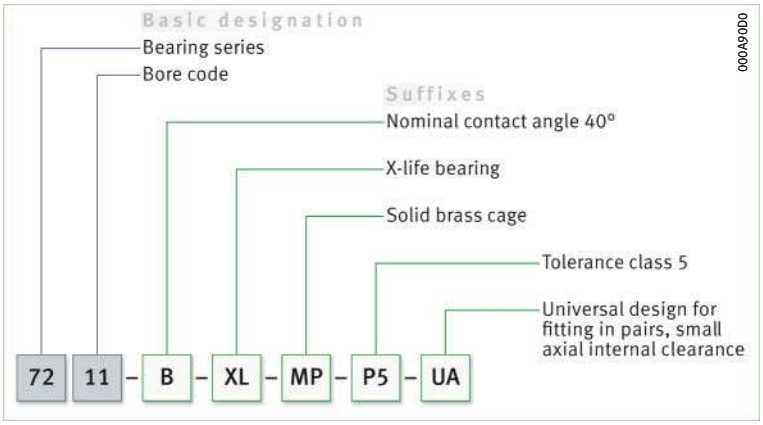
✎*Examples of composition of bearing designation*

The designation of bearings follows a set model. Examples ➤*293*|⧉*9* and ➤*294*|⧉*10*. The composition of designations is subject to DIN 623-1 ➤*102*|⧉*10*.

⧉*9*
Single row angular contact ball bearing of basic design: designation structure



10
Single row angular contact ball bearing of universal design: designation structure



1.14 Dimensioning

Equivalent dynamic bearing load

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

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 directly in the rating life equation for P ($P = F_r$).

✎ *P is a substitute force for combined load and various load cases*

If this condition is not met, a constant radial force must first be determined for the rating life calculation that (in relation to the rating life) represents an equivalent load. This force is known as the equivalent dynamic bearing load P.

✎ *$F_a/F_r \leqq 1,14$ or $F_a/F_r > 1,14$*

The calculation of P is dependent on the load ratio F_a/F_r and the factor 1,14.

✎ *Tandem arrangement*

For single bearings under dynamic load and bearing pairs in a tandem arrangement ➤*294* | *1* and ➤*294* | *2*.

1
Equivalent dynamic load

$$\frac{F_a}{F_r} \leqq 1,14 \quad \Rightarrow \quad P = F_r$$

2
Equivalent dynamic load

$$\frac{F_a}{F_r} > 1,14 \quad \Rightarrow \quad P = 0,35 \cdot F_r + 0,57 \cdot F_a$$

Legend

P	N	Equivalent dynamic bearing load
F_r	N	Radial load
F_a	N	Resulting axial force ➤*295*	*7*. The information in the section “Calculation of internal resulting axial force F_a for single bearings and for bearings in a tandem arrangement” must be taken into consideration when calculating F_a ➤*295*.

✎ *Bearing pairs in O or X arrangement*

For bearing pairs under dynamic load in O or X arrangement ➤*294* | *3* and ➤*294* | *4*.

3
Equivalent dynamic load

$$\frac{F_a}{F_r} \leqq 1,14 \quad \Rightarrow \quad P = F_r + 0,55 \cdot F_a$$

4
Equivalent dynamic load

$$\frac{F_a}{F_r} > 1,14 \quad \Rightarrow \quad P = 0,57 \cdot F_r + 0,93 \cdot F_a$$

Legend

P	N	Equivalent dynamic bearing load
F_r	N	Radial load
F_a	N	Resulting axial force ➤*294*	*2* and ➤*295*	*7*.

Calculation of internal resulting axial force F_a for single bearings and for bearings in a tandem arrangement

Equations for calculation of internal resulting axial force F_a

Single row angular contact ball bearings transmit radial forces from one raceway to the other oblique to the bearing axis. In the case of a shaft supported by two single row angular contact ball bearings of identical or different size, the radial load on bearing A therefore leads, due to the inclination of the raceways ($\alpha \neq 0°$), to an axial load on bearing B. The radial load on bearing B also has the effect of an axial load on bearing A; external forces in bearing systems of this type ➤295|11 and ➤295|12. This internal resulting axial force F_a must be taken into consideration in the calculation of the equivalent dynamic bearing load P. Equations for calculation of resulting axial force F_a ➤295|7. The table shows the magnitude of the resulting axial force – that is the sum of or the difference between the internal and external axial force – for bearing arrangements in accordance with ➤295|11 and ➤295|12.
The following applies to the table: the bearing aligned to the external axial force K_a is marked A and the opposing bearing is marked B.

Preconditions for calculation

Bearing A is subjected to a radial load F_{rA}, bearing B to a radial load F_{rB} ➤295|11 and ➤295|12. F_{rA} and F_{rB} act at the central pressure points of the bearings (dimension a in the product tables) and are always regarded as positive. The bearings are clearance-free, but without preload.

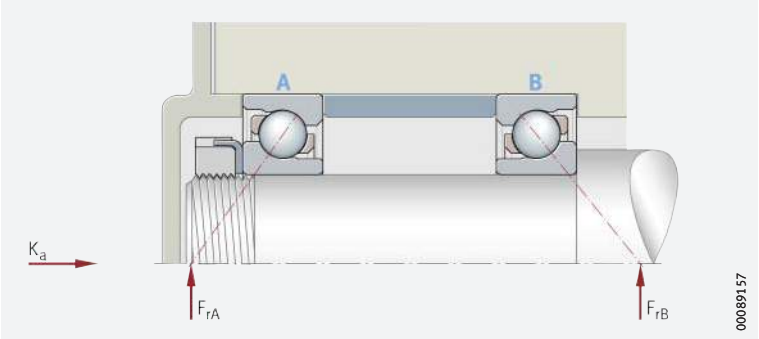
7
Calculation of internal resulting axial force F_a

F_a = *internal resulting axial force, which must be used in the calculation of the equivalent dynamic bearing load P.*
$Y_A = Y_B = 0{,}57$

Case	Load ratio	External axial force	Resulting axial force F_a	
			Bearing A	Bearing B
1	$\frac{F_{rA}}{Y_A} \leqq \frac{F_{rB}}{Y_B}$	$K_a \geqq 0$	$F_a = K_a + 0{,}5 \cdot \frac{F_{rB}}{Y_B}$	F_a is not taken into consideration in the calculation
2	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$	$K_a > 0{,}5 \cdot \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B}\right)$	$F_a = K_a + 0{,}5 \cdot \frac{F_{rB}}{Y_B}$	F_a is not taken into consideration in the calculation
3	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$	$K_a \leqq 0{,}5 \cdot \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B}\right)$	F_a is not taken into consideration in the calculation	$F_a = 0{,}5 \cdot \frac{F_{rA}}{Y_A} - K_a$

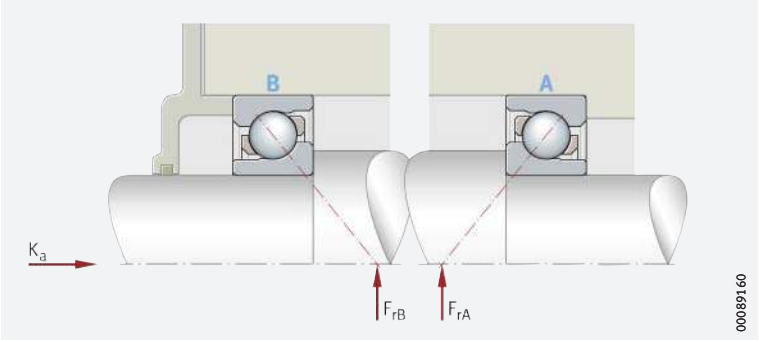
11
Adjusted bearing arrangement with two single row angular contact ball bearings in O arrangement, external forces

K_a = *external axial force acting on the bearing*
F_{rA} = *radial load, bearing A*
F_{rB} = *radial load, bearing B*



12
Adjusted bearing arrangement with two single row angular contact ball bearings in X arrangement, external forces

K_a = *external axial force acting on the bearing*
F_{rA} = *radial load, bearing A*
F_{rB} = *radial load, bearing B*

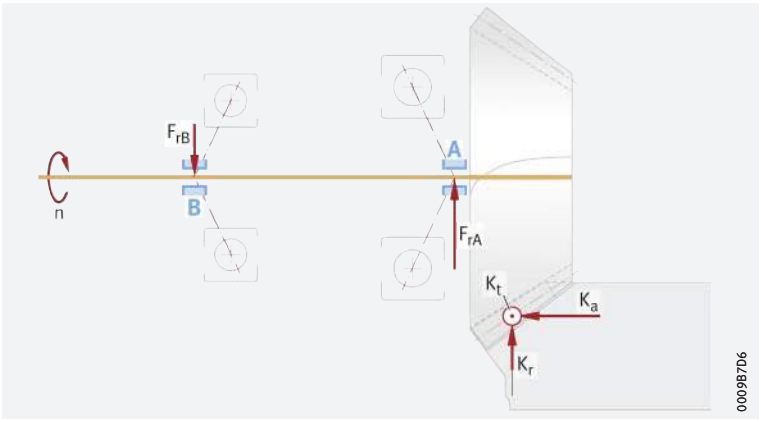


Example of calculation of internal resulting axial force F_a

Bearing arrangement for pinion shaft

Single row angular contact ball bearings are used for the bearing arrangement of a pinion shaft ➤*296*| *13*. The bearing arrangement should be adjusted and in an O arrangement. In order to calculate the basic rating life, the equivalent dynamic bearing load P must be determined.

13
Load scheme for pinion shaft



K_a = *external axial force = 6,52 kN*
K_r = *external radial force = 0,82 kN*
K_t = *tangential force = 5,88 kN*

Resulting radial forces F_r
Bearing A, F_{rA} = 7,30 kN
Bearing B, F_{rB} = 2,20 kN

In a bearing arrangement with two single bearings, the resulting axial force F_a must be taken into consideration

Bearing A supports the external axial force K_a. Since this is an adjusted bearing arrangement with two single bearings, the internal resulting axial force F_a in the bearing system must be taken into consideration in the bearing calculation in accordance with ➤*295*| *7*. For both angular contact ball bearings $Y_A = Y_B = 0{,}57$. Loads ➤*296*| *13*.

Step 1

Calculate the load ratio using ➤*296*| *5*.

5
Load ratio

$$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$$

$$\frac{7{,}30\ \text{kN}}{0{,}57} > \frac{2{,}20\ \text{kN}}{0{,}57}$$

Step 2

Compare the result with possible cases ➤*295*| *7*. Case 2 or case 3 can be considered ➤*296*| *8*.

8
Calculation of internal resulting axial force F_a

Parameters ➤294| 2
$Y_A = Y_B = 0{,}57$

Case	Load ratio	External axial force	Resulting axial force F_a	
			Bearing A	Bearing B
2	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$	$K_a > 0{,}5 \cdot \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B}\right)$	$F_a = K_a + 0{,}5 \cdot \frac{F_{rB}}{Y_B}$	–
3		$K_a \leqq 0{,}5 \cdot \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B}\right)$	–	$F_a = 0{,}5 \cdot \frac{F_{rA}}{Y_A} - K_a$

Step 3

Using ➤297| 𝑓6, check whether case 2 applies ➤296| ▦8.

𝑓6
External axial force in relation to load ratio

$$K_a > 0{,}5\left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B}\right)$$

$$6{,}52\,\text{kN} > 0{,}5\left(\frac{7{,}30\,\text{kN}}{0{,}57} - \frac{2{,}20\,\text{kN}}{0{,}57}\right)$$
$$> 0{,}5\left(12{,}807\,\text{kN} - 3{,}859\,\text{kN}\right)$$
$$6{,}52\,\text{kN} > 4{,}474\,\text{kN}$$

If case 2 applies ➤296| ▦8.

Step 4

✎ *Calculating F_a*

Using ➤297| 𝑓7, calculate the internal resulting axial force F_a for bearing A. The calculations are in accordance with ➤296| ▦8, case 2.

𝑓7
Internal resulting axial force

$$F_a = K_a + 0{,}5 \cdot \frac{F_{rB}}{Y_B}$$

$$F_a = 6{,}52\,\text{kN} + 0{,}5 \cdot \frac{2{,}20\,\text{kN}}{0{,}57}$$
$$= 8{,}45\,\text{kN}$$

✎ *Using value F_a in the calculation of P*

For calculation of the equivalent dynamic bearing load P, the calculated value for F_a in ➤294| 𝑓2 is then used for bearing A, since $F_a/F_{rA} > 1{,}14$ (8,45 kN/7,30 kN > 1,14).

Equivalent static bearing load

✎ *Tandem arrangement*

For single bearings under static load and bearing pairs in a tandem arrangement ➤297| 𝑓8 and ➤297| 𝑓9.

𝑓8
Equivalent static load

$$\frac{F_{0a}}{F_{0r}} \leqq 1{,}9 \quad \Rightarrow \quad P_0 = F_{0r}$$

𝑓9
Equivalent static load

$$\frac{F_{0a}}{F_{0r}} > 1{,}9 \quad \Rightarrow \quad P_0 = 0{,}5 \bullet F_{0r} + 0{,}26 \bullet F_{0a}$$

Legend

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

For bearing pairs under static load in an O or X arrangement ➤297| 𝑓10.

𝑓10
Equivalent static load

$$P_0 = F_{0r} + 0{,}52 \cdot F_{0a}$$

Legend

P_0	N	Equivalent static bearing load
F_{0r}, F_{0a}	N	Largest radial or axial 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 ➤ *298* | *f 11*.

f 11
Static load safety factor

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

Legend

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 $P > C_{0r}/100$ is required*

In order that no slippage occurs between the contact partners, the angular contact ball bearings must be constantly subjected to a sufficiently high load. Based on experience, a minimum radial load of the order of $P > C_{0r}/100$ 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

✎ *Support bearing rings over their entire circumference and width*

In order to allow full utilisation of the load carrying capacity of the bearings and thus also achieve the requisite rating life, the bearing rings must be rigidly and uniformly supported by means of contact surfaces over their entire circumference and over the entire width of the raceway. Support can be provided by means of a cylindrical seating surface. The seating and contact surfaces should not be interrupted by grooves, holes or other recesses. The accuracy of mating parts must meet specific requirements ➤ *299* | ▦ *9* to ➤ *300* | ▦ *11*.

Radial location of bearings – fit recommendations

✎ *For secure radial location, tight fits are necessary*

In addition to supporting the rings adequately, the bearings must also be securely located in a radial direction, to prevent creep of the bearing rings on the mating parts under load. This is generally achieved by means of tight fits between the bearing rings and the mating parts. If the rings are not secured adequately or correctly, this can cause severe damage to the bearings and adjacent machine parts. Influencing factors, such as the conditions of rotation, magnitude of the load, internal clearance, temperature conditions, design of the mating parts and the mounting and dismounting options must be taken into consideration in the selection of fits.

If shock type loads occur, tight fits (transition fit or interference fit) are required to prevent the rings from coming loose at any point. Clearance, transition or interference fits ➤ *150* | ▦ *6* and ➤ *158* | ▦ *7*.

The following information provided in Technical principles must be taken into consideration in the design of bearing arrangements:

- conditions of rotation ➤ *145*
- tolerance classes for cylindrical shaft seats (radial bearings) ➤ *147* | ▦ *2*
- shaft fits ➤ *150*
- tolerance classes for bearing seats in housings (radial bearings) ➤ *148* | ▦ *4*
- housing fits ➤ *158*

Axial location of bearings – location methods

The bearings must also be securely located in an axial direction

As a tight fit alone is not normally sufficient to also locate the bearing rings securely on the shaft and in the housing bore in an axial direction, this must usually be achieved by means of an additional axial location or retention method. The axial location of the bearing rings must be matched to the type of bearing arrangement. Shaft and housing shoulders, housing covers, nuts, spacer rings and retaining rings etc., are fundamentally suitable ➤*295*|*11* and ➤*295*|*12*.

Dimensional, geometrical and running accuracy of the bearing seats

A minimum of IT6 should be provided for the shaft seat and a minimum of IT7 for the housing seat

The accuracy of the bearing seat on the shaft and in the housing should correspond to the accuracy of the bearing used. For single row angular contact ball bearings with the tolerance class Normal, the shaft seat should correspond to a minimum of standard tolerance grade IT6 and the housing seat to a minimum of IT7; with tolerance class 6, the shaft seat should correspond to a minimum of IT5 and the housing seat to IT6. Guide values for the geometrical and positional tolerances of bearing seating surfaces ➤*299*|*9*, tolerances t_1 to t_3 in accordance with ➤*168*|*11*. Numerical values for IT grades ➤*299*|*10*.

9
Guide values for the geometrical and positional tolerances of bearing seating surfaces

Bearing tolerance class		Bearing seating surface	Standard tolerance grades to ISO 286-1 (IT grades)			
to ISO 492	to DIN 620		Diameter tolerance	Roundness tolerance t_1	Parallelism tolerance t_2	Total axial runout tolerance of abutment shoulder t_3
Normal	PN (P0)	Shaft	IT6 (IT5)	Circumferential load IT4/2	Circumferential load IT4/2	IT4
				Point load IT5/2	Point load IT5/2	
		Housing	IT7 (IT6)	Circumferential load IT5/2	Circumferential load IT5/2	IT5
				Point load IT6/2	Point load IT6/2	
6	P6	Shaft	IT5	Circumferential load IT3/2	Circumferential load IT3/2	IT3
				Point load IT4/2	Point load IT4/2	
		Housing	IT6	Circumferential load IT4/2	Circumferential load IT4/2	IT4
				Point load IT5/2	Point load IT5/2	

10
Numerical values for ISO standard tolerances (IT grades) to ISO 286-1:2010

IT grade	Nominal dimension in mm							
	over	**3**	**6**	**10**	**18**	**30**	**50**	**80**	**120**
	incl.	**6**	**10**	**18**	**30**	**50**	**80**	**120**	**180**
	Values in µm							
IT3	2,5		2,5	3	4	4	5	6	8
IT4	4		4	5	6	7	8	10	12
IT5	5		6	8	9	11	13	15	18
IT6	8		9	11	13	16	19	22	25
IT7	12		15	18	21	25	30	35	40

Roughness of cylindrical bearing seats

Ra must not be too high

The roughness of the bearing seats must be matched to the tolerance class of the bearings. The mean roughness value Ra must not be too high, in order to maintain the interference loss within limits. The shafts must be ground, while the bores must be precision turned. Guide values as a function of the IT grade of bearing seating surfaces ➤*300*| *11*.

11
Roughness values for cylindrical bearing seating surfaces – guide values

Nominal diameter of the bearing seat d (D) mm		Recommended mean roughness value for ground bearing seats Ramax µm			
		Diameter tolerance (IT grade)			
over	incl.	IT7	IT6	IT5	IT4
–	80	1,6	0,8	0,4	0,2
80	500	1,6	1,6	0,8	0,4

Mounting dimensions for the contact surfaces of bearing rings

The contact surfaces for the rings must be of sufficient height

The mounting dimensions of the shaft and housing shoulders, and spacer rings etc., must ensure that the contact surfaces for the bearing rings are of sufficient height. However, they must also reliably prevent rotating parts of the bearing from grazing stationary parts. Proven mounting dimensions for the radii and diameters of abutment shoulders ➤*304*|. These dimensions are limiting dimensions (maximum or minimum dimensions); the actual values should not be higher or lower than specified.

If single row angular contact bearings are mounted in a tandem arrangement, it must be ensured that the end faces of the outer rings in contact with each other have sufficient overlap. In case of doubt, please consult Schaeffler.

Adjustment of bearings

Always adjust single bearings against a second bearing

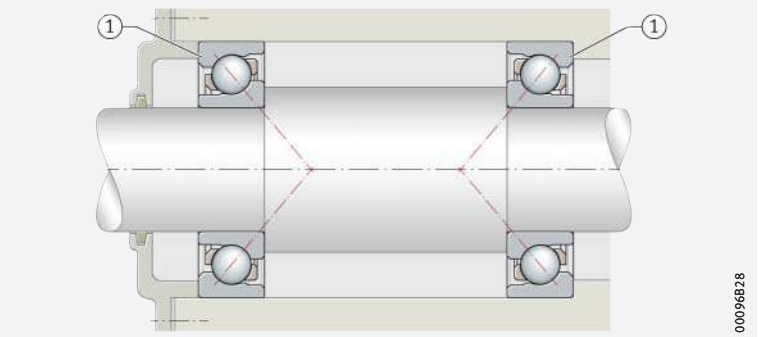
Single row angular contact ball bearings must always be used with a second bearing or as a bearing set ➤*300*| *14*. If two individual single row angular contact ball bearings are used, these must be adjusted against each other until the requisite preload or desired clearance is achieved.

Select the adjustment such that full function and operational reliability of the bearings is ensured

The correct adjustment of the bearings has a considerable influence on the function and operational reliability of the bearing arrangement. If the clearance is too large, the load carrying capacity of the bearings will not be fully utilised; if the preload is too high, the increased friction losses will give rise to higher operating temperatures, which will, in turn, have a negative effect on the rating life of the bearings.

14
Adjusted bearing arrangement with two single row angular contact ball bearings

① *Angular contact ball bearings mounted in X arrangement*



Adjustment not required for bearing sets

Universal bearings arranged immediately adjacent to each other, or matched bearings, do not need to be adjusted. In such cases, the desired operating clearance or required preload is achieved by selecting the internal clearance or preload class in conjunction with the suitable shaft and housing fits. As a result, particular attention must be paid to the correct selection of internal clearance or preload for these bearing sets.

1.17 Mounting and dismounting

The mounting and dismounting options for angular contact ball bearings, by thermal, hydraulic or mechanical methods, must be taken into consideration in the design of the bearing position.

Ensure that the bearings are not damaged during mounting

Single row angular contact ball bearings are not separable. In the mounting of such bearings, the mounting forces must always be applied to the bearing ring with a tight fit.

Schaeffler Mounting Handbook

Rolling bearings must be handled with great care

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.

1.18 Legal notice regarding data freshness

The further development of products may also result in technical changes to catalogue products

Of central interest to Schaeffler is the further development and optimisation of its products and the satisfaction of its customers. In order that you, as the customer, can keep yourself optimally informed about the progress that is being made here and with regard to the current technical status of the products, we publish any product changes which differ from the printed version in our electronic product catalogue.

We therefore reserve the right to make changes to the data and illustrations in this catalogue. This catalogue reflects the status at the time of printing. More recent publications released by us (as printed or digital media) will automatically precede this catalogue if they involve the same subject. Therefore, please always use our electronic product catalogue to check whether more up-to-date information or modification notices exist for your desired product.

Link to electronic product catalogue

The following link will take you to the Schaeffler electronic product catalogue: ➤ *https://medias.schaeffler.com*.

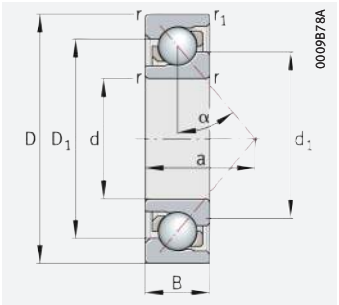
1.19 Further information

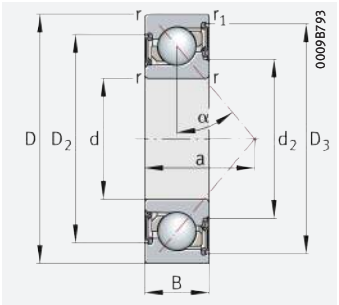
In addition to the data in this chapter, the following chapters in Technical principles must also be observed in the design of bearing arrangements:

- Determining the bearing size ➤*34*
- Rigidity ➤*54*
- Friction and increases in temperature ➤*56*
- Speeds ➤*64*
- Bearing data ➤*97*
- Lubrication ➤*70*
- Sealing ➤*182*
- Design of bearing arrangements ➤*139*
- Mounting and dismounting ➤*191*.

Angular contact ball bearings

Single row



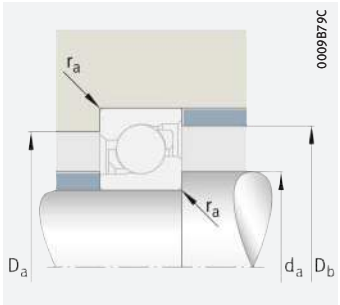


With seal 2RS

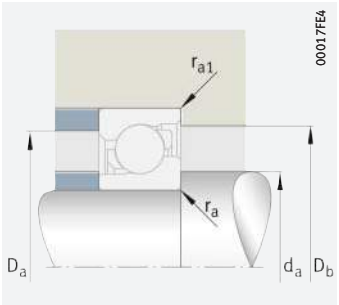
d = 10 – 20 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤293 | 1.12 ➤293 | 1.13 X-life ➤285
			N	N	N	min^{-1}	min^{-1}	≈ kg	
10	30	9	5 300	2 600	174	34 500	22 600	0,033	**7200-B-XL-JP**
	30	9	5 300	2 600	174	34 500	22 600	0,032	**7200-B-XL-TVP**
	30	9	5 300	2 600	174	16 100	–	0,037	**7200-B-XL-2RS-TVP**
12	32	10	7 400	3 550	241	30 000	21 100	0,037	**7201-B-XL-JP**
	32	10	7 400	3 550	241	30 000	21 100	0,038	**7201-B-XL-TVP**
	32	10	7 400	3 550	241	14 800	–	0,037	**7201-B-XL-2RS-TVP**
	37	12	11 400	5 300	355	25 500	16 300	0,066	**7301-B-XL-JP**
	37	12	11 400	5 300	355	25 500	16 300	0,06	**7301-B-XL-TVP**
15	35	11	8 400	4 450	300	27 000	19 100	0,045	**7202-B-XL-JP**
	35	11	8 400	4 450	300	27 000	19 100	0,044	**7202-B-XL-TVP**
	35	11	8 400	4 450	300	12 800	–	0,048	**7202-B-XL-2RS-TVP**
	42	13	14 200	7 200	485	22 200	14 200	0,084	**7302-B-XL-JP**
	42	13	14 200	7 200	485	22 200	14 200	0,081	**7302-B-XL-TVP**
	42	13	14 200	7 200	485	11 100	–	0,082	**7302-B-XL-2RS-TVP**
17	40	12	10 500	5 700	380	23 400	17 100	0,067	**7203-B-XL-JP**
	40	12	10 500	5 700	380	23 400	17 100	0,065	**7203-B-XL-TVP**
	40	12	10 500	5 700	380	11 100	–	0,068	**7203-B-XL-2RS-TVP**
	47	14	17 600	9 000	610	19 600	12 800	0,117	**7303-B-XL-JP**
	47	14	17 600	9 000	610	19 600	12 800	0,11	**7303-B-XL-TVP**
	47	14	17 600	9 000	610	9 800	–	0,112	**7303-B-XL-2RS-TVP**
20	42	12	14 500	8 000	540	20 500	14 400	0,061	**7004-B-XL-TVP**
	42	12	14 500	8 000	540	9 800	–	0,061	**7004-B-XL-2RS-TVP**
	47	14	14 000	7 800	520	19 700	15 400	0,106	**7204-B-XL-JP**
	47	14	14 000	7 800	520	19 700	15 400	0,103	**7204-B-XL-TVP**
	47	14	14 000	7 800	520	9 500	–	0,107	**7204-B-XL-2RS-TVP**
	52	15	20 400	11 100	750	17 600	11 500	0,149	**7304-B-XL-JP**
	52	15	20 400	11 100	750	17 600	11 500	0,147	**7304-B-XL-TVP**
	52	15	20 400	11 100	750	8 600	–	0,147	**7304-B-XL-2RS-TVP**

medias ➤ *https://www.schaeffler.de/std/1DED*



Mounting dimensions

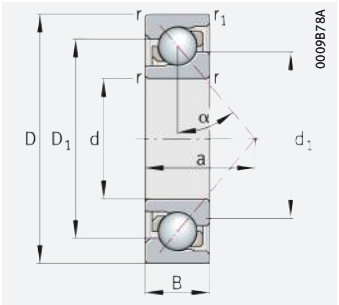


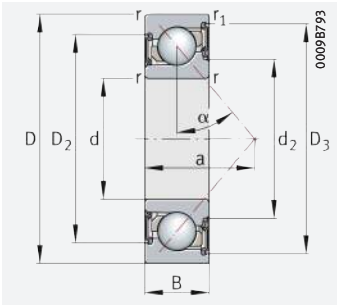
Mounting dimensions

Dimensions									Nominal contact angle	Mounting dimensions				
d	r	r_1	D_1	D_2	D_3	d_1	d_2	a	α	d_a	D_a	D_b	r_a	r_{a1}
	min.	min.	≈	≈	≈	≈	≈	≈	°	min.	max.	max.	max.	max.
10	0,6	0,3	22	–	–	18,3	–	13	40	14,2	25,8	27,6	0,6	0,3
	0,6	0,3	22	–	–	18,3	–	13	40	14,2	25,8	27,6	0,6	0,3
	0,6	0,3	22	23,2	25,4	–	15,5	13	40	14,2	25,8	27,6	0,6	0,3
12	0,6	0,3	24,6	–	–	19,8	–	14	40	16,2	27,8	29,6	0,6	0,3
	0,6	0,3	24,6	–	–	19,8	–	14	40	16,2	27,8	29,6	0,6	0,3
	0,6	0,3	24,6	25,9	28,8	–	17	14	40	16,2	27,8	29,6	0,6	0,3
	1	0,6	27,2	–	–	22,3	–	16	40	17,6	31,4	32,8	1	0,6
	1	0,6	27,2	–	–	22,3	–	16	40	17,6	31,4	32,8	1	0,6
15	0,6	0,3	27,6	–	–	22,8	–	16	40	19,2	30,8	32,6	0,6	0,3
	0,6	0,3	27,6	–	–	22,8	–	16	40	19,2	30,8	32,6	0,6	0,3
	0,6	0,3	27,6	29,2	32,1	–	19,7	16	40	19,2	30,8	32,6	0,6	0,3
	1	0,6	31,7	–	–	26	–	18	40	20,6	36,4	37,8	1	0,6
	1	0,6	31,7	–	–	26	–	18	40	20,6	36,4	37,8	1	0,6
	1	0,6	31,7	33,3	38,1	–	22,9	18	40	20,6	36,4	37,8	1	0,6
17	0,6	0,3	31,5	–	–	26	–	18	40	21,2	35,8	37,6	0,6	0,6
	0,6	0,3	31,5	–	–	26	–	18	40	21,2	35,8	37,6	0,6	0,6
	0,6	0,3	31,5	33,1	36,3	–	22,9	18	40	21,2	35,8	37,6	0,6	0,6
	1	0,6	35,5	–	–	29,2	–	20	40	22,6	41,4	42,8	1	0,6
	1	0,6	35,5	–	–	29,2	–	20	40	22,6	41,4	42,8	1	0,6
	1	0,6	35,5	37,2	42,6	–	26,1	20	40	22,6	41,4	42,8	1	0,6
20	0,6	0,3	34,8	–	–	28,9	–	12	40	23,2	38,8	40	0,6	0,3
	0,6	0,3	34,8	35,5	39,8	–	26,5	12	40	23,2	38,8	40	0,6	0,3
	1	0,6	37	–	–	30,5	–	21	40	25,6	41,4	42,8	1	0,6
	1	0,6	37	–	–	30,5	–	21	40	25,6	41,4	42,8	1	0,6
	1	0,6	37	39,2	43	–	26,8	21	40	25,6	41,4	42,8	1	0,6
	1,1	0,6	39,7	–	–	33	–	23	40	27	45	47,8	1	0,6
	1,1	0,6	39,7	–	–	33	–	23	40	27	45	47,8	1	0,6
	1,1	0,6	39,7	41,4	47,1	–	30	23	40	27	45	47,8	1	0,6

Angular contact ball bearings

Single row

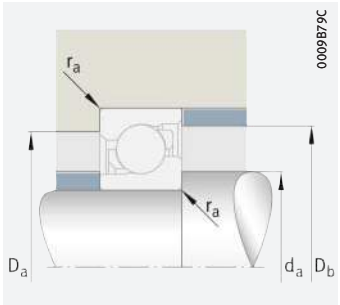




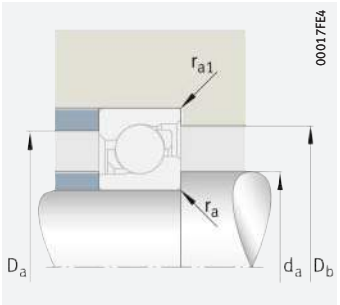
With seal 2RS

d = 25 – 35 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤293 | 1.12 ➤293 | 1.13 X-life ➤285
			N	N	N	min^{-1}	min^{-1}	≈ kg	
25	47	12	16 000	9 900	670	18 100	12 000	0,071	**7005-B-XL-TVP**
	47	12	16 000	9 900	670	7 900	–	0,071	**7005-B-XL-2RS-TVP**
	52	15	15 300	9 000	600	17 400	13 700	0,13	**7205-B-XL-JP**
	52	15	15 300	9 000	600	17 400	13 700	0,127	**7205-B-XL-TVP**
	52	15	15 300	9 000	600	8 000	–	0,132	**7205-B-XL-2RS-TVP**
	62	17	28 000	15 800	1 070	14 300	9 800	0,242	**7305-B-XL-JP**
	62	17	28 000	15 800	1 070	14 300	9 800	0,223	**7305-B-XL-TVP**
	62	17	28 000	15 800	1 070	7 100	–	0,231	**7305-B-XL-2RS-TVP**
	80	21	43 500	26 000	1 750	15 100	7 500	0,585	**7405-B-XL-MP**
30	42	7	5 600	4 550	295	20 600	9 600	0,026	**71806-B-TVH**
	55	13	19 900	13 400	900	15 200	10 200	0,109	**7006-B-XL-TVP**
	55	13	19 900	13 400	900	6 500	–	0,109	**7006-B-XL-2RS-TVP**
	62	16	21 700	14 100	950	14 400	11 200	0,203	**7206-B-XL-JP**
	62	16	21 700	14 100	950	14 400	11 200	0,197	**7206-B-XL-TVP**
	62	16	21 700	14 100	950	6 500	–	0,204	**7206-B-XL-2RS-TVP**
	72	19	35 500	22 100	1 490	12 300	8 600	0,362	**7306-B-XL-JP**
	72	19	35 500	22 100	1 490	12 300	8 600	0,341	**7306-B-XL-TVP**
	72	19	35 500	22 100	1 490	6 000	–	0,341	**7306-B-XL-2RS-TVP**
	90	23	51 000	30 500	2 050	13 100	6 800	0,791	**7406-B-XL-MP**
35	47	7	6 000	5 300	350	18 100	8 200	0,029	**71807-B-TVH**
	62	14	24 300	17 200	1 160	13 400	9 000	0,14	**7007-B-XL-TVP**
	62	14	24 300	17 200	1 160	6 000	–	0,14	**7007-B-XL-2RS-TVP**
	72	17	28 000	19 000	1 280	12 200	9 600	0,29	**7207-B-XL-JP**
	72	17	28 000	19 000	1 280	12 200	9 600	0,282	**7207-B-XL-TVP**
	72	17	28 000	19 000	1 280	5 600	–	0,292	**7207-B-XL-2RS-TVP**
	80	21	43 000	27 500	1 860	10 800	7 900	0,48	**7307-B-XL-JP**
	80	21	43 000	27 500	1 860	10 800	7 900	0,48	**7307-B-XL-TVP**
	80	21	43 000	27 500	1 860	5 300	–	0,477	**7307-B-XL-2RS-TVP**
	100	25	65 000	43 000	2 900	11 000	5 400	1,014	**7407-B-XL-MP**



Mounting dimensions

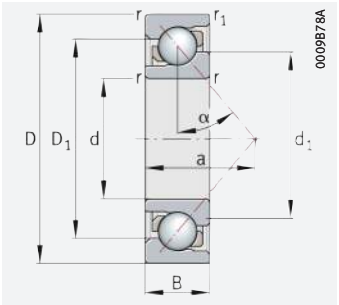


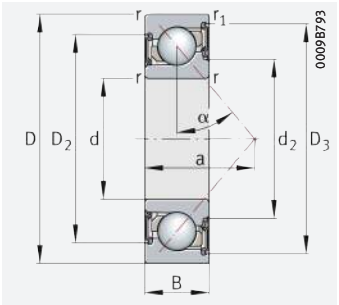
Mounting dimensions

Dimensions									Nominal contact angle	Mounting dimensions				
d	r	r_1	D_1	D_2	D_3	d_1	d_2	a	α	d_a	D_a	D_b	r_a	r_{a1}
	min.	min.	≈	≈	≈	≈	≈	≈	°	min.	max.	max.	max.	max.
25	0,6	0,3	39,8	–	–	33,9	–	21	40	28,2	43,8	45	0,6	0,3
	0,6	0,3	39,8	40,5	44,8	–	31,5	21	40	28,2	43,8	45	0,6	0,3
	1	0,6	42	–	–	35,5	–	24	40	30,6	46,4	47,8	1	0,6
	1	0,6	42	–	–	35,5	–	24	40	30,6	46,4	47,8	1	0,6
	1	0,6	42	44,1	48	–	31,8	24	40	30,6	46,4	47,8	1	0,6
	1,1	0,6	48	–	–	39,9	–	27	40	32	55	57,8	1	0,6
	1,1	0,6	48	–	–	39,9	–	27	40	32	55	57,8	1	0,6
	1,1	0,6	48	50,3	57,1	–	36,2	27	40	32	55	57,8	1	0,6
	1,5	1	57,9	–	–	48,2	–	33	40	36	69	74,4	1,5	1
30	0,3	0,2	37,3	–	–	34,7	–	18,6	40	32	40	40	0,3	0,2
	1	0,6	47,1	–	–	41,3	–	24	40	34,6	50,4	51,8	1	0,6
	1	0,6	47,1	47,7	51,9	–	38	24	40	34,6	50,4	51,8	1	0,6
	1	0,6	49,5	–	–	43,2	–	27	40	35,6	56,4	57,8	1	0,6
	1	0,6	49,5	–	–	43,2	–	27	40	35,6	56,4	57,8	1	0,6
	1	0,6	49,5	51,7	57,1	–	39,5	27	40	35,6	56,4	57,8	1	0,6
	1,1	0,6	55,9	–	–	47,1	–	31	40	37	65	67,8	1	0,6
	1,1	0,6	55,9	–	–	47,1	–	31	40	37	65	67,8	1	0,6
	1,1	0,6	55,9	58,5	65,9	–	42,7	31	40	37	65	67,8	1	0,6
	1,5	1	66	–	–	55,3	–	37	40	41	79	84,4	1,5	1
35	0,3	0,2	42,3	–	–	39,7	–	20,7	40	37	45	45,6	0,3	0,2
	1	0,6	53,4	–	–	47	–	27	40	39,6	57,4	58,8	1	0,6
	1	0,6	53,4	54	58,9	–	43,6	27	40	39,6	57,4	58,8	1	0,6
	1,1	0,6	57,6	–	–	50,2	–	31	40	42	65	67,8	1	0,6
	1,1	0,6	57,6	–	–	50,2	–	31	40	42	65	67,8	1	0,6
	1,1	0,6	57,6	60,2	66,5	–	45,8	31	40	42	65	67,8	1	0,6
	1,5	1	63	–	–	53,1	–	35	40	44	71	74,4	1,5	1
	1,5	1	63	–	–	53,1	–	35	40	44	71	74,4	1,5	1
	1,5	1	63	65,6	73,9	–	48,7	35	40	44	71	74,4	1,5	1
	1,5	1	79,8	–	–	66,7	–	41	40	46	94,4	100	1,5	1

Angular contact ball bearings

Single row

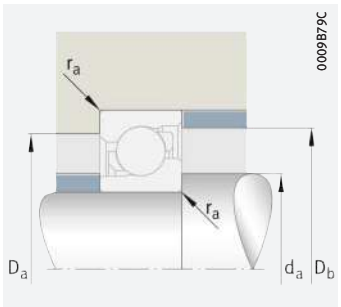




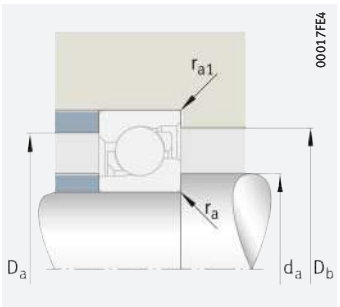
With seal 2RS

d = 40 – 55 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤293 | 1.12 ➤293 | 1.13 X-life ➤285
			N	N	N	min^{-1}	min^{-1}	≈ kg	
40	52	7	6 300	5 800	395	16 200	7 200	0,033	**71808-B-TVH**
	68	15	28 000	20 300	1 370	12 100	8 400	0,176	**7008-B-XL-TVP**
	68	15	28 000	20 300	1 370	5 200	–	0,17	**7008-B-XL-2RS-TVP**
	80	18	34 000	23 500	1 580	10 900	8 600	0,372	**7208-B-XL-JP**
	80	18	34 000	23 500	1 580	10 900	8 600	0,367	**7208-B-XL-TVP**
	80	18	34 000	23 500	1 580	5 000	–	0,379	**7208-B-XL-2RS-TVP**
	90	23	53 000	34 500	2 320	9 500	7 100	0,646	**7308-B-XL-JP**
	90	23	53 000	34 500	2 320	9 500	7 100	0,61	**7308-B-XL-TVP**
	90	23	53 000	34 500	2 320	4 650	–	0,61	**7308-B-XL-2RS-TVP**
	110	27	75 000	50 000	3 400	9 900	5 000	1,338	**7408-B-XL-MP**
45	58	7	6 600	6 500	450	14 500	6 300	0,041	**71809-B-TVH**
	85	19	37 500	27 000	1 810	10 000	8 000	0,411	**7209-B-XL-JP**
	85	19	37 500	27 000	1 810	10 000	8 000	0,405	**7209-B-XL-TVP**
	85	19	37 500	27 000	1 810	4 550	–	0,405	**7209-B-XL-2RS-TVP**
	100	25	65 000	43 000	2 900	8 400	6 500	0,937	**7309-B-XL-JP**
	100	25	65 000	43 000	2 900	8 400	6 500	0,937	**7309-B-XL-TVP**
	120	29	86 000	61 000	4 100	9 100	4 650	1,684	**7409-B-XL-MP**
50	65	7	7 000	7 400	520	12 900	5 400	0,058	**71810-B-TVH**
	90	20	39 000	28 500	1 920	9 300	7 600	0,466	**7210-B-XL-JP**
	90	20	39 000	28 500	1 920	9 300	7 600	0,456	**7210-B-XL-TVP**
	90	20	39 000	28 500	1 920	4 200	–	0,468	**7210-B-XL-2RS-TVP**
	110	27	75 000	50 000	3 400	7 600	6 100	1,13	**7310-B-XL-JP**
	110	27	75 000	50 000	3 400	7 600	6 100	1,05	**7310-B-XL-TVP**
	130	31	96 000	69 000	4 650	8 300	4 400	2,054	**7410-B-XL-MP**
55	72	9	11 800	11 800	760	11 400	5 600	0,084	**71811-B-TVH**
	100	21	49 000	38 500	2 600	8 300	6 800	0,645	**7211-B-XL-JP**
	100	21	49 000	38 500	2 600	8 300	6 800	0,604	**7211-B-XL-TVP**
	120	29	86 000	61 000	4 100	7 000	5 600	1,46	**7311-B-XL-JP**
	120	29	86 000	61 000	4 100	7 000	5 600	1,38	**7311-B-XL-TVP**
	140	33	110 000	82 000	5 400	7 700	4 150	2,64	**7411-B-XL-MP**



Mounting dimensions



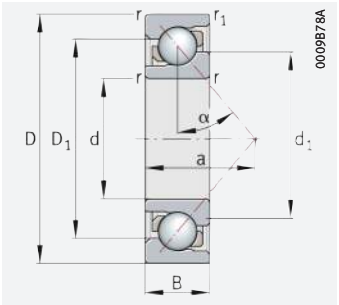
Mounting dimensions

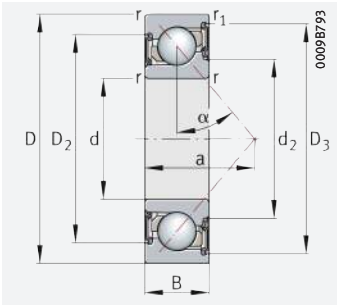
Dimensions									Nominal contact angle	Mounting dimensions				
d	r	r_1	D_1	D_2	D_3	d_1	d_2	a	α	d_a	D_a	D_b	r_a	r_{a1}
	min.	min.	≈	≈	≈	≈	≈	≈	°	min.	max.	max.	max.	max.
40	0,3	0,2	47,3	–	–	44,7	–	22,8	40	42	50	50	0,3	0,2
	1	0,6	58,8	–	–	51,9	–	30	40	44,6	63,4	64,8	1	0,6
	1	0,6	58,8	59,4	65	–	48,3	30	40	44,6	63,4	64,8	1	0,6
	1,1	0,6	64,4	–	–	56,4	–	34	40	47	73	75,8	1	0,6
	1,1	0,6	64,4	–	–	56,4	–	34	40	47	73	75,8	1	0,6
	1,1	0,6	64,4	67	73,8	–	52	34	40	47	73	75,8	1	0,6
	1,5	1	71,3	–	–	60	–	39	40	49	81	84,4	1,5	1
	1,5	1	71,3	–	–	60	–	39	40	49	81	84,4	1,5	1
	1,5	1	71,3	73,9	83,3	–	55,6	39	40	49	81	84,4	1,5	1
	2	1	87,6	–	–	73,1	–	45	40	53	97	104,4	2	1
45	0,3	0,2	52,8	–	–	50,2	–	25,1	40	47	56	56	0,3	0,2
	1,1	0,6	69,8	–	–	61,2	–	37	40	52	78	80,8	1	0,6
	1,1	0,6	69,8	–	–	61,2	–	37	40	52	78	80,8	1	0,6
	1,1	0,6	69,8	72,4	79,6	–	56,8	37	40	52	78	80,8	1	0,6
	1,5	1	79,8	–	–	66,7	–	43	40	54	91	94,4	1,5	1
	1,5	1	79,8	–	–	66,7	–	43	40	54	91	94,4	1,5	1
	2	1	95,3	–	–	80,3	–	49	40	58	107	114,4	2	1
50	0,3	0,2	59,3	–	–	56,7	–	27,8	40	52	63	63	0,3	0,2
	1,1	0,6	74,8	–	–	66,3	–	39	40	57	83	85,8	1	0,6
	1,1	0,6	74,8	–	–	66,3	–	39	40	57	83	85,8	1	0,6
	1,1	0,6	74,8	77,4	84,6	–	61,8	39	40	57	83	85,8	1	0,6
	2	1	87,6	–	–	73,1	–	47	40	61	99	104,4	2	1
	2	1	87,6	–	–	73,1	–	47	40	61	99	104,4	2	1
	2,1	1,1	103,4	–	–	87,3	–	53	40	64	116	121	2,1	1
55	0,3	0,2	65,3	–	–	61,7	–	31,1	40	57	70	70	0,3	0,2
	1,5	1	83	–	–	72,6	–	43	40	64	91	94,4	1,5	1
	1,5	1	83	–	–	72,6	–	43	40	64	91	94,4	1,5	1
	2	1	95,3	–	–	80,3	–	51	40	66	109	114,4	2	1
	2	1	95,3	–	–	80,3	–	51	40	66	109	114,4	2	1
	2,1	1,1	111,5	–	–	95,3	–	57	40	69	126	131	2,1	1

Angular contact ball bearings

Single row

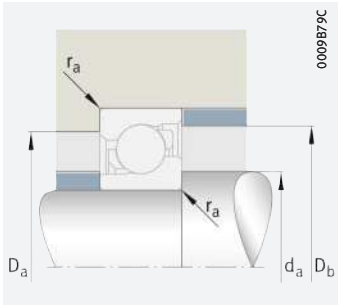
d = 60 – 80 mm



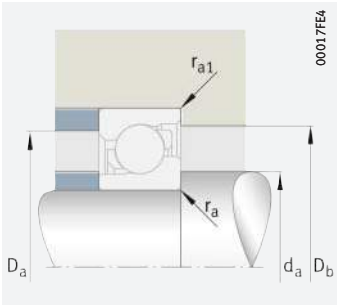


With seal 2RS

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤293 | 1.12 ➤293 | 1.13 X-life ➤285
			N	N	N	min^{-1}	min^{-1}	≈ kg	
60	78	10	12 300	12 800	840	10 500	5 400	0,11	**71812-B-TVH**
	110	22	59 000	45 000	3 050	7 500	6 200	0,782	**7212-B-XL-JP**
	110	22	59 000	45 000	3 050	7 500	6 200	0,808	**7212-B-XL-TVP**
	110	22	59 000	45 000	3 050	3 450	–	0,78	**7212-B-XL-2RS-TVP**
	130	31	96 000	69 000	4 650	6 400	5 300	1,74	**7312-B-XL-JP**
	130	31	96 000	69 000	4 650	6 400	5 300	1,71	**7312-B-XL-TVP**
	150	35	126 000	93 000	6 000	7 100	3 950	3,106	**7412-B-XL-MP**
65	85	10	15 200	15 800	970	9 600	4 850	0,13	**71813-B-TVH**
	120	23	67 000	55 000	3 700	6 900	5 700	1,08	**7213-B-XL-JP**
	120	23	67 000	55 000	3 700	6 900	5 700	1	**7213-B-XL-TVP**
	140	33	110 000	82 000	5 400	5 900	5 000	2,22	**7313-B-XL-JP**
	140	33	110 000	82 000	5 400	5 900	5 000	2,12	**7313-B-XL-TVP**
	160	37	140 000	107 000	6 700	6 600	3 800	3,709	**7413-B-XL-MP**
70	90	10	15 800	17 200	1 070	9 000	4 500	0,14	**71814-B-TVH**
	125	24	74 000	62 000	4 200	6 500	5 400	1,17	**7214-B-XL-JP**
	125	24	74 000	62 000	4 200	6 500	5 400	1,08	**7214-B-XL-TVP**
	125	24	74 000	62 000	4 200	3 000	–	1,081	**7214-B-XL-2RS-TVP**
	150	35	126 000	93 000	6 000	5 500	4 750	2,76	**7314-B-XL-JP**
	150	35	126 000	93 000	6 000	5 500	4 750	2,58	**7314-B-XL-TVP**
	180	42	167 000	138 000	8 100	5 800	3 450	5,386	**7414-B-XL-MP**
75	95	10	16 200	18 100	1 140	8 500	4 150	0,15	**71815-B-TVH**
	130	25	73 000	62 000	4 100	6 300	5 300	1,25	**7215-B-XL-JP**
	130	25	73 000	62 000	4 100	6 300	5 300	1,16	**7215-B-XL-TVP**
	160	37	140 000	107 000	6 700	5 100	4 500	3,29	**7315-B-XL-JP**
	160	37	140 000	107 000	6 700	5 100	4 500	3,1	**7315-B-XL-TVP**
	190	45	167 000	138 000	8 100	5 800	3 750	6,7	**7415-B-XL-MP**
80	100	10	16 500	19 100	1 200	8 000	3 900	0,155	**71816-B-TVH**
	140	26	85 000	72 000	4 650	5 800	4 950	1,53	**7216-B-XL-JP**
	140	26	85 000	72 000	4 650	5 800	4 950	1,42	**7216-B-XL-TVP**
	170	39	155 000	124 000	7 500	4 750	4 250	3,86	**7316-B-XL-JP**
	170	39	155 000	124 000	7 500	4 750	4 250	3,66	**7316-B-XL-TVP**
	200	48	200 000	169 000	9 600	5 300	3 600	7,477	**7416-B-XL-MP**



Mounting dimensions



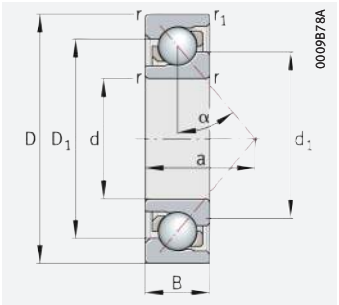
Mounting dimensions

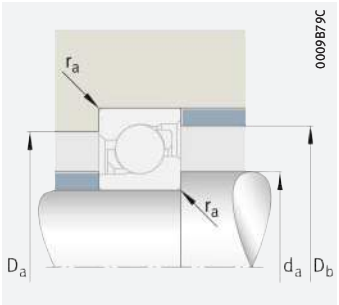
Dimensions									Nominal contact angle	Mounting dimensions				
d	r	r_1	D_1	D_2	D_3	d_1	d_2	a	α	d_a	D_a	D_b	r_a	r_{a1}
	min.	min.	≈	≈	≈	≈	≈	≈	°	min.	max.	max.	max.	max.
60	0,3	0,2	70,8	–	–	67,2	–	33,9	40	62	76	76,6	0,3	0,2
	1,5	1	90,8	–	–	80,3	–	47	40	69	101	104,4	1,5	1
	1,5	1	90,8	–	–	80,3	–	47	40	69	101	104,4	1,5	1
	1,5	1	90,8	94,4	103,4	–	75,3	47	40	69	101	104,4	1,5	1
	2,1	1,1	103,4	–	–	87,3	–	55	40	72	118	123	2,1	1
	2,1	1,1	103,4	–	–	87,3	–	55	40	72	118	123	2,1	1
	2,1	1,1	119,6	–	–	102,3	–	62	40	74	136	141	2,1	1
65	0,6	0,3	77	–	–	73	–	36,5	40	68,2	81,8	83	0,6	0,3
	1,5	1	98,9	–	–	86,3	–	51	40	74	111	114,4	1,5	1
	1,5	1	98,9	–	–	86,3	–	51	40	74	111	114,4	1,5	1
	2,1	1,1	111,5	–	–	95,3	–	60	40	77	128	133	2,1	1
	2,1	1,1	111,5	–	–	95,3	–	60	40	77	128	133	2,1	1
	2,1	1,1	128	–	–	109,2	–	66	40	79	146	151	2,1	1
70	0,6	0,3	82	–	–	78	–	38,5	40	73,2	86,8	88	0,6	0,3
	1,5	1	104	–	–	92,3	–	53	40	79	116	119,4	1,5	1
	1,5	1	104	–	–	92,3	–	53	40	79	116	119,4	1,5	1
	1,5	1	104	107,6	117,9	–	87,3	53	40	79	116	119,4	1,5	1
	2,1	1,1	119,6	–	–	102,3	–	64	40	82	138	143	2,1	1
	2,1	1,1	119,6	–	–	102,3	–	64	40	82	138	143	2,1	1
	3	1,1	144,3	–	–	123,1	–	73	40	86	164	171	2,5	1
75	0,6	0,3	87	–	–	83	–	40,7	40	78,2	91,8	93	0,6	0,3
	1,5	1	109,2	–	–	96,5	–	56	40	84	121	124,4	1,5	1
	1,5	1	109,2	–	–	96,5	–	56	40	84	121	124,4	1,5	1
	2,1	1,1	128	–	–	109,2	–	68	40	87	148	153	2,1	1
	2,1	1,1	128	–	–	109,2	–	68	40	87	148	153	2,1	1
	3	1,1	144,3	–	–	123,1	–	78	40	91	174	181	2,5	1
80	0,6	0,3	92	–	–	88	–	42,8	40	85,2	96,8	98	0,6	0,3
	2	1	117,2	–	–	102,9	–	59	40	91	129	134,4	2	1
	2	1	117,2	–	–	102,9	–	59	40	91	129	134,4	2	1
	2,1	1,1	136,7	–	–	115,7	–	72	40	92	158	163	2,1	1
	2,1	1,1	136,7	–	–	115,7	–	72	40	92	158	163	2,1	1
	3	1,1	153,9	–	–	129	–	83	40	96	184	191	2,5	1

Angular contact ball bearings

Single row

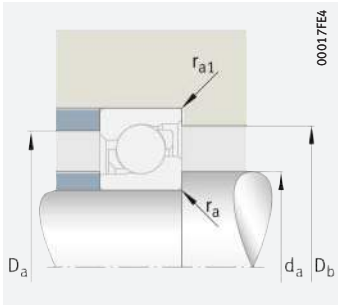
d = 85 – 180 mm





Mounting dimensions

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤293 | 1.12 ➤293 | 1.13 X-life ➤285
			N	N	N	min^{-1}	min^{-1}	≈ kg	
85	150	28	97 000	86 000	5 300	5 400	4 750	1,94	**7217-B-XL-JP**
	150	28	97 000	86 000	5 300	5 400	4 750	1,82	**7217-B-XL-TVP**
	180	41	167 000	138 000	8 100	4 450	4 100	4,4	**7317-B-XL-JP**
	180	41	167 000	138 000	8 100	4 450	4 100	4,26	**7317-B-XL-TVP**
90	160	30	114 000	98 000	5 900	5 000	4 550	2,38	**7218-B-XL-JP**
	160	30	114 000	98 000	5 900	5 000	4 550	2,21	**7218-B-XL-TVP**
	190	43	180 000	155 000	8 800	4 200	3 900	5,14	**7318-B-XL-JP**
	190	43	180 000	155 000	8 800	4 200	3 900	5	**7318-B-XL-TVP**
95	170	32	123 000	106 000	6 200	4 700	4 450	2,64	**7219-B-XL-TVP**
	200	45	189 000	167 000	9 300	4 000	3 800	5,93	**7319-B-XL-JP**
	200	45	189 000	167 000	9 300	4 000	3 800	5,78	**7319-B-XL-TVP**
100	180	34	148 000	132 000	7 500	4 400	4 200	3,45	**7220-B-XL-JP**
	180	34	142 000	124 000	7 100	4 400	4 250	3,17	**7220-B-XL-TVP**
	215	47	214 000	197 000	10 600	3 700	3 550	7,38	**7320-B-XL-JP**
	215	47	214 000	197 000	10 600	3 700	3 550	7,16	**7320-B-XL-TVP**
105	190	36	155 000	142 000	7 900	5 400	4 100	4,18	**7221-B-XL-MP**
	225	49	225 000	214 000	11 200	4 600	3 400	9,3	**7321-B-XL-MP**
110	200	38	167 000	154 000	8 300	3 950	3 950	4,7	**7222-B-XL-JP**
	200	38	167 000	154 000	8 300	3 950	3 950	4,44	**7222-B-XL-TVP**
	240	50	250 000	245 000	12 500	3 300	3 150	9,97	**7322-B-XL-JP**
	240	50	250 000	245 000	12 500	3 300	3 150	9,74	**7322-B-XL-TVP**
120	215	40	182 000	178 000	9 300	3 650	3 700	5,4	**7224-B-XL-TVP**
	260	55	275 000	285 000	13 900	3 050	2 850	12,52	**7324-B-XL-TVP**
130	230	40	200 000	204 000	10 300	3 400	3 350	6,12	**7226-B-XL-TVP**
	280	58	305 000	325 000	15 400	2 800	2 600	15,1	**7326-B-XL-TVP**
140	250	42	214 000	231 000	11 100	4 050	3 100	8,55	**7228-B-XL-MP**
	300	62	310 000	375 000	12 700	3 350	2 400	20,5	**7328-B-MP**
150	270	45	245 000	275 000	12 800	3 750	2 850	10,9	**7230-B-XL-MP**
	320	65	340 000	430 000	14 200	3 150	2 200	24,8	**7330-B-MP**
160	290	48	241 000	305 000	10 400	3 500	2 650	13,5	**7232-B-MP**
170	310	52	270 000	355 000	11 600	3 250	2 440	16,7	**7234-B-MP**
180	320	52	280 000	380 000	12 100	3 100	2 290	17,503	**7236-B-MP**



Mounting dimensions

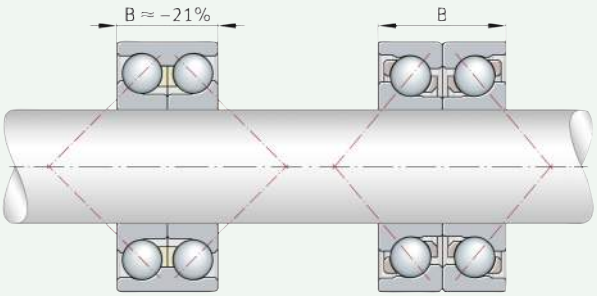
Dimensions						Nominal contact angle	Mounting dimensions				
d	r min.	r_1 min.	D_1 ≈	d_1 ≈	a ≈	α °	d_a min.	D_a max.	D_b max.	r_a max.	r_{a1} max.
85	2	1	125	110,6	63	40	96	139	144,4	2	1
	2	1	125	110,6	63	40	96	139	144,4	2	1
	3	1,1	144	122	76	40	99	166	173	2,5	1
	3	1,1	144	122	76	40	99	166	173	2,5	1
90	2	1	133,4	117,5	67	40	101	149	154,4	2	1
	2	1	133,4	117,5	67	40	101	149	154,4	2	1
	3	1,1	152,4	130,1	80	40	104	176	183	2,5	1
	3	1,1	152,4	130,1	80	40	104	176	183	2,5	1
95	2,1	1,1	141,5	125,3	72	40	107	158	163	2,1	1
	3	1,1	159,5	137,1	84	40	109	186	193	2,5	1
	3	1,1	159,5	137,1	84	40	109	186	193	2,5	1
100	2,1	1,1	149,6	132,3	76	40	112	168	173	2,1	1
	2,1	1,1	149,6	132,3	76	40	112	168	173	2,1	1
	3	1,1	171,7	146,3	90	40	114	201	208	2,5	1
	3	1,1	171,7	146,3	90	40	114	201	208	2,5	1
105	2,1	1,1	157,7	138,2	80	40	117	178	183	2,1	1
	3	1,1	178,9	154	94	40	119	211	218	2,5	1
110	2,1	1,1	165,7	144,9	84	40	122	188	193	2,1	1
	2,1	1,1	165,7	144,9	84	40	122	188	193	2,1	1
	3	1,1	190,9	162,3	98	40	124	226	233	2,5	1
	3	1,1	190,9	162,3	98	40	124	226	233	2,5	1
120	2,1	1,1	178,9	157,2	90	40	132	203	208	2,1	1
	3	1,1	207,1	176,4	107	40	134	246	253	2,5	1
130	3	1,1	191,8	169,6	96	40	144	216	223	2,5	1
	4	1,5	222,5	188,5	115	40	147	263	271	3	1,5
140	3	1,1	207,5	183,5	103	40	154	236	243	2,5	1
	4	1,5	239,5	204,4	123	40	157	283	291	3	1,5
150	3	1,1	223,5	197,5	111	40	164	256	263	2,5	1
	4	1,5	255,8	218,3	131	40	167	303	311	3	1,5
160	3	1,1	238	212	118	40	174	276	283	2,5	1
170	4	1,5	255,8	227,4	127	40	187	293	301	3	1,5
180	4	1,5	265,8	237,4	131	40	197	303	311	3	1,5

2 Double row angular contact ball bearings

Double row angular contact ball bearings are particularly suitable where:

- the design envelope is not sufficient under high loads for a pair of single row angular contact ball bearings
- high radial and axial loads are acting simultaneously
- tilting moments must also be supported
- a relatively rigid bearing arrangement is required
- the bearing arrangement is to run quietly in addition to meeting the requirements stated above.

For an overview of other product-specific features, see the Matrix for bearing preselection ➤*280*.



1 *Double row angular contact ball bearing – comparison of design envelope with bearing set composed of single row angular contact ball bearings*

B = *total width of bearing or bearing set*

2.1 Bearing design

✎ *Design variants*

Double row angular contact ball bearings are available as:

- bearings of basic design ➤*315*|*2*
- bearings with filling slot ➤*315*|*3*
- bearings with split inner ring ➤*316*|*4*
- X-life bearings ➤*316*.

Larger catalogue bearings and other bearing designs ➤ 🕮 *GL 1*.

Bearings of basic design

✎ *Comparable with a pair of single row angular contact ball bearings*

Double row bearings correspond in their structure to a pair of single row angular contact ball bearings in an O arrangement, but they are narrower to a certain extent. They differ in the size of the contact angle α and the design of the bearing rings. Due to the manufacturing processes used, open bearings, which are also available with sealing washers or sealing shields, can have turned recesses in the outer and/or inner ring for sealing washers or sealing shields.

✎ *Extensive and versatile range of product variants*

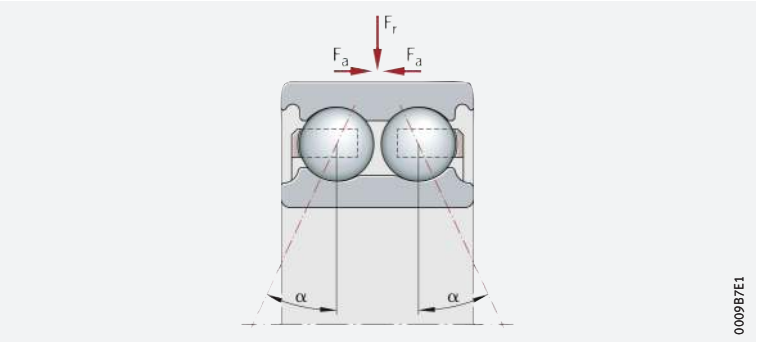
Bearings of series 38..-B(-2RSR, -2Z), 30..-B(-2RSR, -2Z), 32..-B(-2RSR, -2Z), 32..-BD(-2HRS), 33..-B(-2RSR, -2Z), 33..BD(-2HRS) are self-retaining. They do not have filling slots in the end faces of the bearings rings ➤*315*|*2*. Bearings of series 32..-BD and 33..-BD have an optimised internal construction.

In design terms, double row angular contact ball bearings thus fulfil the requirements for:

- supporting axial loads in both directions and high radial loads
- low-noise running
- versatile application.

✎ *Nominal contact angle* $\alpha = 25°$ *or* $30°$

The nominal contact angle α in B designs is 25°, in the case of the BD variant, this is 30°.



2 *Double row angular contact ball bearing of basic design*

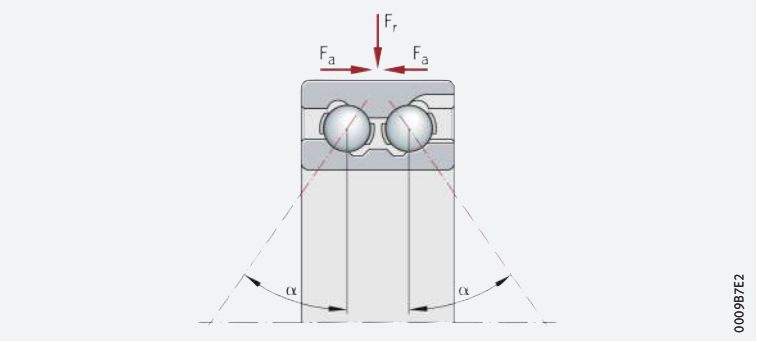
F_r = *radial load*
F_a = *axial load*
α = *nominal contact angle*

Bearings with filling slot

✎ *Nominal contact angle* $\alpha = 35°$

Angular contact ball bearings of series 32 and 33 are self-retaining. They have filling slots on one end face of the bearing ring for filling the bearings with rolling elements ➤*315*|*3*. The nominal contact angle is $\alpha = 35°$.

These series must be fitted such that the main load direction is supported by the row of balls without filling slots under axial load.



3 *Double row angular contact ball bearing with filling slot*

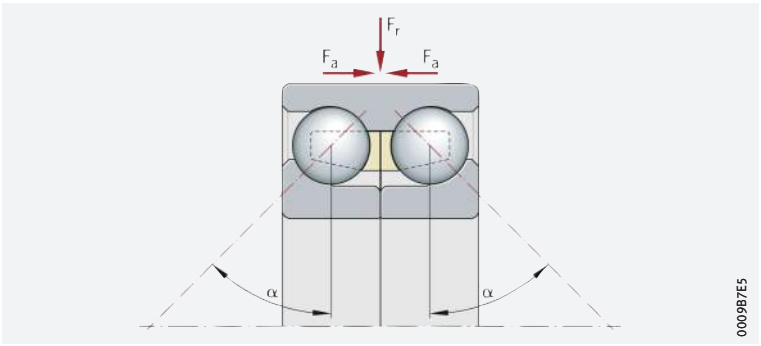
F_r = *radial load*
F_a = *axial load*
α = *nominal contact angle*

Bearings with split inner ring

✎ *Nominal contact angle* $\alpha = 45°$

In angular contact ball bearings of series 33..-DA, the inner ring is split ➤*316*|*4*. The inner rings are not self-retaining. Filling the bearings with a large number of balls – in conjunction with the internal design of the bearing and the contact angle of 45° – allows high alternating axial loads to be supported.

The inner ring halves are matched to the particular bearing and must not be interchanged with those of other bearings of the same size.



4
Double row angular contact ball bearing with split inner ring

F_r = *radial load*
F_a = *axial load*
α = *nominal contact angle*

X-life premium quality

Bearings of series 32..-BD and 33..-BD are X-life bearings ➤*330*|▦. These bearings exhibit considerably higher performance than standard double row angular contact ball bearings ➤*316*|🗀 *5*. This is achieved, for example, through the modified internal construction, higher surface quality of the contact surfaces and optimised cage design, as well as through the improved quality of the steel and rolling elements.

Advantages

✎ Increased customer benefits due to X-life

The technical enhancements offer a range of advantages, such as:

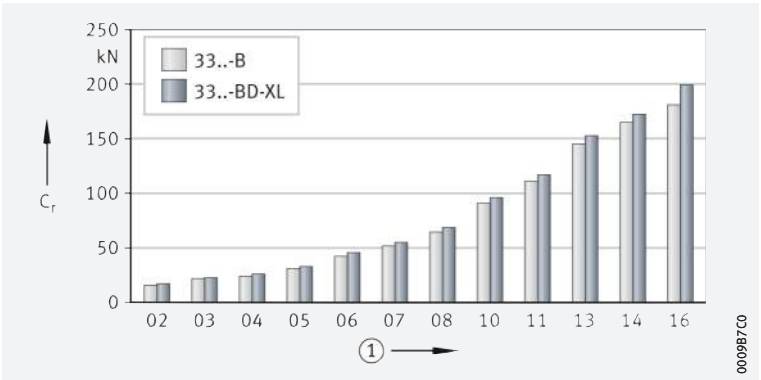
- a more favourable load distribution in the bearing and thus a higher dynamic load carrying capacity of the bearings ➤*316*|🗀 *5*
- quieter running
- running with reduced friction and greater energy efficiency
- lower heat generation in the bearing
- higher possible speeds
- lower lubricant consumption and, consequently, longer maintenance intervals
- a measurably longer operating life of the bearings
- high operational security
- compact, environmentally-friendly bearing arrangements.

✎ Lower operating costs, higher machine availability

In conclusion, these advantages improve the overall cost-efficiency of the bearing position significantly and thus bring about a sustainable increase in the efficiency of the machine and equipment.

✎ Suffix XL

X-life angular contact ball bearings include the suffix XL in the designation ➤*322*|🗀 *7*, ➤*323*|🗀 *8* and ➤*330*|▦.



5
Comparison of basic dynamic load rating C_r – bearing series 33..-BD-XL, bore code 02 to 16, with a bearing which is not of X-life quality (33..-B)

C_r = *basic dynamic load rating*
① *Bore code*

Areas of application

Wide application range

Due to their special technical features, double row X-life angular contact ball bearings are highly suitable for bearing arrangements in:

- compressors
- fluid and hydraulic pumps
- automotive chassis and gearboxes
- industrial gearboxes
- agricultural vehicles
- elevators and packaging equipment
- heavy motorbikes
- machine tools
- textile machinery.

X-life indicates a high product performance density and thus a particularly significant benefit to the customer. Further information on X-life ➤*10*.

2.2 Load carrying capacity

Capable of supporting axial loads in both directions and radial loads

In addition to high radial loads, double row angular contact ball bearings can also support axial forces in both directions and tilting moments ➤*315*|*2*. They are highly suitable for bearing arrangements with rigid axial guidance.

Contact angle and axial load carrying capacity

The bearings are available with α = 25°, 30°, 35° and 45° ➤*315*|*2* to ➤*316*|*4*. The axial load carrying capacity increases with the size of the contact angle. In bearings without filling slots, it is the same in both directions.

2.3 Compensation of angular misalignments

The angular adjustment facility is very limited

The bearings are not suitable for the compensation of angular misalignments. In addition, misalignments induce internal forces, which not only lead to higher temperatures, but also to a reduction in the bearing rating life.

2.4 Lubrication

Angular contact ball bearings sealed on both sides are maintenance-free

Open bearings and bearings with seals on both sides are greased using a high quality grease. Bearings sealed on both sides are maintenance-free for many applications, i. e. they do not require relubrication.

Open bearings must be lubricated

Angular contact ball bearings without seals and with seals on one side of series 32.., 33.., 33..-DA, 32..-BD and 33..-BD are preserved and not greased. These bearings must be lubricated with oil or grease.

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.

2.5 Sealing

2RS, 2RSR and 2HRS seals are contact designs

Series 38..-B, 30..-B, 32..-B and 33..-B with the suffix 2RS, 2RSR and 2HRS have lip seals in axial contact on both sides and in radial contact ➤*322*| 5. Bearings with the suffix RS, HRS and RSR are sealed on one side with lip seals in axial and radial contact.

2Z sealing shields and 2RZ seals are non-contact designs

Bearing series with the suffix 2Z have sheet steel sealing shields on both sides. Bearings with the suffix 2RZ are fitted with rubberised gap seals on both sides.

Open bearings

In the case of unsealed bearings, sealing must be carried out by the adjacent construction. The sealing system should reliably prevent:

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

2.6 Speeds

Limiting speeds and reference speeds in the product tables

The product tables give two speeds for most bearings ➤*330*|:

- the kinematic limiting speed n_G
- the thermal speed rating $n_{\vartheta r}$.

Limiting speeds

The limiting speed n_G is the kinematically permissible speed of the bearing. Even under favourable mounting and operating conditions, this value should not be exceeded without prior consultation with Schaeffler ➤*64*.

The values given in the product tables are valid for oil lubrication in the case of bearings without seals or shields and for grease lubrication where bearings are supplied greased and with seals or shields.

Values for grease lubrication

For grease lubrication, 75% of the value stated in the product tables is permissible in each case.

Reference speeds

$n_{\vartheta r}$ is used to calculate n_ϑ

The thermal speed rating $n_{\vartheta r}$ is not an application-oriented speed limit, but is a calculated ancillary value for determining the thermally safe operating speed n_ϑ ➤*64*.

Bearings with contact seals

For bearings with contact seals, no reference speeds are defined in accordance with DIN ISO 15312:2004. As a result, only the limiting speed n_G is given in the product tables for these bearings.

2.7 Noise

The Schaeffler Noise Index (SGI) has been developed as a new feature for comparing the noise level of different bearing types and series. As a result, a noise evaluation of rolling bearings can now be carried out for the first time.

Schaeffler Noise Index

The SGI value is based on the maximum permissible noise level of a bearing in accordance with internal standards, which is calculated on the basis of ISO 15242. In order that different bearing types and series can be compared, the SGI value is plotted against the basic static load rating C_0.

This permits direct comparisons between bearings with the same load carrying capacity. The upper limit value is given in each of the diagrams. This means that the average noise level of the bearings is lower than illustrated in the diagram.

The Schaeffler Noise Index is an additional performance characteristic in the selection of bearings for noise-sensitive applications. The specific suitability of a bearing for an application in terms of installation space, load carrying capacity or speed limit for example, must be checked independently of this.

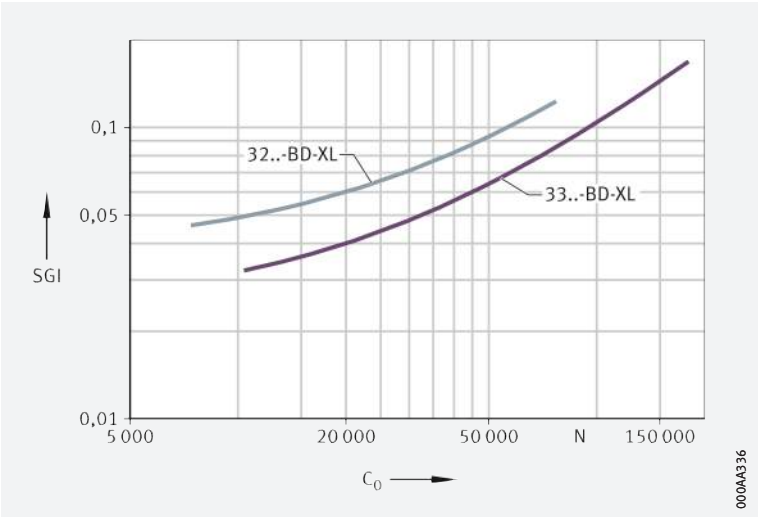
The Noise Index is currently available for the main series. Additional series will be updated and introduced in subsequent publications.

Further information:

- ***medias*** ➤ *https://medias.schaeffler.com*.

6
Schaeffler Noise Index for double row angular contact ball bearings

SGI = *Schaeffler Noise Index*
C_0 = *basic static load rating*



2.8 Temperature range

✎ *Limiting values*

The operating temperature of the bearings is limited by:

- the dimensional stability of the bearing rings and rolling elements
- the cage
- the lubricant
- the seals.

Possible operating temperatures of double row angular contact ball bearings ➤*319*| ▦ *1*.

1
Permissible temperature ranges

Operating temperature	Double row angular contact ball bearings, open		Double row angular contact ball bearings, sealed
	with sheet steel or brass cage	with polyamide cage PA66	
	ungreased –30 °C to +150 °C	–30 °C to +120 °C, limited by the cage material	–30 °C to +110 °C, limited by the lubricant and seal material
	series 30, 38, 32..-BD and 33..-BD, D ≦ 90 mm, –30 °C to +120 °C		

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

2.9 Cages

Solid cages made from brass and PA66, as well as sheet steel cages, are used as standard

Standard cages and additional cage designs for double row angular contact ball bearings are made from brass, polyamide or steel ➤*320*|▦*2*. 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 brass or sheet steel cages should be used. If there is any uncertainty regarding cage suitability, please consult Schaeffler.

▦*2*
Cage, cage suffix, bore code

Bearing series	Solid cage made from polyamide PA66 TVH, TVP		Solid brass cage M, MA		Sheet steel cage –	
	standard	also available for	standard	also available for	standard	also available for
	Bore code					
32	–	–	19, 21, 22	18, 20	17, 18, 20	–
33	–	–	17, 19, 20, 22	18	14 to 16, 18	20
30..-B	up to 08	–	–	–	–	–
32..-B	00, 01, 14 to 18, 20	–	–	–	–	–
33..-B	01, 12	–	–	–	–	–
38..-B	00 to 12, 14, 16, 18, 20	–	–	–	–	–
32..-BD	–	02 to 13	–	–	02 to 13	–
33..-BD	–	02 to 11, 13, 14, 16	–	–	04 to 11, 13, 14	–
33..-DA	05	–	08, 10, 11, 15 to 22	05, 06, 07, 09, 12, 13, 14	06, 07, 09, 12, 13, 14	05

2.10 Internal clearance

Axial internal clearance – bearings with unsplit inner ring

Double row angular contact ball bearings with unsplit inner ring of the basic design have the axial internal clearance CN (group N) in accordance with DIN 628-3:2008 ➤*321*|▦*3*.

Bearings can also be supplied with an axial internal clearance which is larger or smaller than CN (C3, C4 or C2). In this case, please contact Schaeffler.

3
Axial internal clearance of double row angular contact ball bearings with unsplit inner ring

Nominal bore diameter d mm		Axial internal clearance							
		C2 (Group 2) µm		CN (Group N) µm		C3 (Group 3) µm		C4 (Group 4) µm	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
–	10	1	11	5	21	12	28	25	45
10	18	1	12	6	23	13	31	27	47
18	24	2	14	7	25	16	34	27	47
24	30	2	15	8	27	18	37	30	50
30	40	2	16	9	29	21	40	33	54
40	50	2	18	11	33	23	44	36	58
50	65	3	22	13	36	26	48	40	63
65	80	3	24	15	40	30	54	46	71
80	100	3	26	18	46	35	63	55	83
100	120	4	30	22	53	42	73	65	96
120	140	4	34	25	59	48	82	74	108

Axial internal clearance – bearings with split inner ring

Standard corresponds approximately to C3 for unsplit bearings

Bearings with a split inner ring are intended for higher axial loads. As a result, they generally also have a tighter fit than unsplit bearings. Their normal internal clearance corresponds approximately to the internal clearance group C3 for unsplit bearings ➤*321*|▦*4*.

4
Axial internal clearance of double row angular contact ball bearings with split inner ring

Nominal bore diameter d mm		Axial internal clearance					
		C2 (Group 2) µm		CN (Group N) µm		C3 (Group 3) µm	
over	incl.	min.	max.	min.	max.	min.	max.
24	30	8	27	16	35	27	46
30	40	9	29	18	38	30	50
40	50	11	33	22	44	36	58
50	65	13	36	25	48	40	63
65	80	15	40	29	54	46	71

2.11 Dimensions, tolerances

Dimension standards

DIN ISO

The main dimensions of double row angular contact ball bearings correspond to DIN 628-3:2008. Nominal dimensions of double row angular contact ball bearings ➤*330*|▦.

Chamfer dimensions

DIN ISO

The limiting dimensions for chamfer dimensions correspond to DIN 620-6:2004. Overview and limiting values ➤*135*|*7.11*. Nominal value of chamfer dimension ➤*330*|▦.

Tolerances

DIN ISO

The tolerances for the dimensional and running accuracy of double row angular contact ball bearings correspond to tolerance class Normal in accordance with ISO 492:2014; the dimensional and running tolerances of bearings with the suffix BD correspond to the tolerance class 6 in accordance with ISO 492:2014. Tolerance values in accordance with ISO 492 ➤*122*|▦*8* and ➤*124*|▦*11*.

2.12 Suffixes

For a description of the suffixes used in this chapter ➤*322*|▦ *5* and ***medias*** interchange ➤*https://www.schaeffler.de/std/1D52*.

▦ *5*
Suffixes and corresponding descriptions

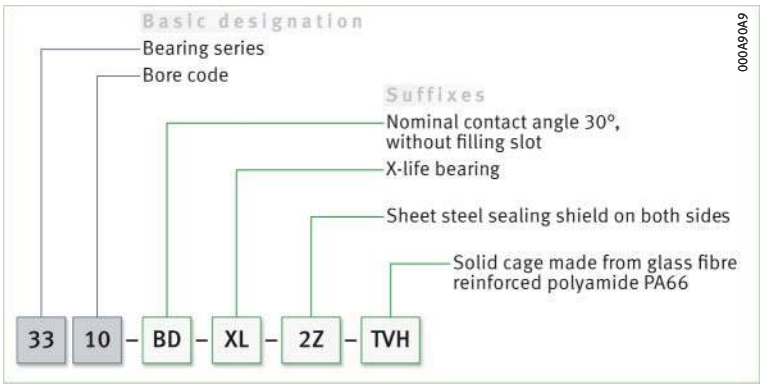
Suffix	Description of suffix	
B	Modified internal construction, nominal contact angle α = 25°, without filling slot	Standard
BD	Modified internal construction, nominal contact angle α = 30°, without filling slot	
C2	Axial internal clearance C2 (smaller than normal)	Available by agreement
C3	Axial internal clearance C3 (larger than normal)	
C4	Axial internal clearance C4 (larger than C3)	
DA	Inner ring split, nominal contact angle α = 45°	Standard
M	Solid brass cage, ball-guided	Standard, dependent on bore code
MA	Solid brass cage, guided on outer ring	
TVH	Solid cage made from glass fibre reinforced polyamide PA66, ball-guided	
2HRS	Contact seal on both sides, axial contact (lip seal)	Standard
2RS	Contact seal on both sides, axial contact (lip seal)	
2RSR	Contact seal on both sides, radial contact (lip seal)	
2RZ	Non-contact seal on both sides (rubberised gap seal)	
2Z	Non-contact sealing shield on both sides (sheet metal gap seal)	
HRS	Contact seal on one side, axial contact (lip seal)	Special design, available by agreement
RS	Contact seal on one side, axial contact (lip seal)	
RSR	Contact seal on one side, radial contact (lip seal)	
RZ	Non-contact seal on one side (rubberised gap seal)	
Z	Non-contact sealing shield on one side (sheet metal gap seal)	
XL	X-life bearing, dependent on bore code and bearing type	

2.13 Structure of bearing designation

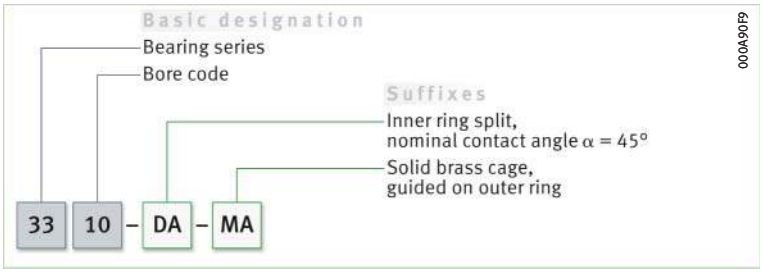
✎ *Examples of composition of bearing designation*

The designation of bearings follows a set model. Examples ➤*322*|⧉ *7* and ➤*323*|⧉ *8*. The composition of designations is subject to DIN 623-1 ➤*102*|⧉ *10*.

⧉ *7*
Double row angular contact ball bearing of basic design: designation structure



8
Double row angular contact ball bearing with split inner ring: designation structure



2.14 Dimensioning

Equivalent dynamic bearing load

✎ *Valid for* $\alpha = 25°, 30°, 35°, 45°$

The calculation of P is dependent on the nominal contact angle α of the bearing, the load ratio F_a/F_r and the calculation factors from ➤*323*|*1* to ➤*323*|*8*.

The further fundamental information on the calculation of the equivalent dynamic bearing load must be observed ➤*294*|*1.14*.

1
Equivalent dynamic load $\alpha = 25°$

$$\frac{F_a}{F_r} \leqq 0{,}68 \Rightarrow P = F_r + 0{,}92 \cdot F_a$$

2
Equivalent dynamic load $\alpha = 25°$

$$\frac{F_a}{F_r} > 0{,}68 \Rightarrow P = 0{,}67 \cdot F_r + 1{,}41 \cdot F_a$$

3
Equivalent dynamic load $\alpha = 30°$

$$\frac{F_a}{F_r} \leqq 0{,}8 \Rightarrow P = F_r + 0{,}78 \cdot F_a$$

4
Equivalent dynamic load $\alpha = 30°$

$$\frac{F_a}{F_r} > 0{,}8 \Rightarrow P = 0{,}63 \cdot F_r + 1{,}24 \cdot F_a$$

5
Equivalent dynamic load $\alpha = 35°$

$$\frac{F_a}{F_r} \leqq 0{,}95 \Rightarrow P = F_r + 0{,}66 \cdot F_a$$

6
Equivalent dynamic load $\alpha = 35°$

$$\frac{F_a}{F_r} > 0{,}95 \Rightarrow P = 0{,}6 \cdot F_r + 1{,}07 \cdot F_a$$

7
Equivalent dynamic load $\alpha = 45°$

$$\frac{F_a}{F_r} \leqq 1{,}34 \Rightarrow P = F_r + 0{,}47 \cdot F_a$$

8
Equivalent dynamic load $\alpha = 45°$

$$\frac{F_a}{F_r} > 1{,}34 \Rightarrow P = 0{,}54 \cdot F_r + 0{,}81 \cdot F_a$$

Legend

P	N	Equivalent dynamic bearing load
F_r	N	Radial load
F_a	N	Axial load.

Equivalent static bearing load

✎ *Valid for $\alpha = 25°, 30°, 35°, 45°$*

The calculation of the equivalent static bearing load P_0 is dependent on the nominal contact angle α and the calculation factors ➤*324* | *9* to ➤*324* | *12*.

9
Equivalent static load
$\alpha = 25°$

$$P_0 = F_{0r} + 0{,}76 \cdot F_{0a}$$

10
Equivalent static load
$\alpha = 30°$

$$P_0 = F_{0r} + 0{,}66 \cdot F_{0a}$$

11
Equivalent static load
$\alpha = 35°$

$$P_0 = F_{0r} + 0{,}58 \cdot F_{0a}$$

12
Equivalent static load
$\alpha = 45°$

$$P_0 = F_{0r} + 0{,}44 \cdot F_{0a}$$

Legend

P_0	N	Equivalent static bearing load
F_{0r}, F_{0a}	N	Largest radial or axial 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 ➤*324* | *13*.

13
Static load safety factor

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

Legend

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

2.15 Minimum load

✎ *In order to prevent damage due to slippage, a minimum radial load of $P > C_{0r}/100$ is required*

In order that no slippage occurs between the contact partners, the double row angular contact ball bearings must be constantly subjected to a sufficiently high load. Based on experience, a minimum radial load of the order of $P > C_{0r}/100$ 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.

2.16 Design of bearing arrangements

Support bearing rings over their entire circumference and width

In order to allow full utilisation of the load carrying capacity of the bearings and thus also achieve the requisite rating life, the bearing rings must be rigidly and uniformly supported by means of contact surfaces over their entire circumference and over the entire width of the raceway. Support can be provided by means of a cylindrical seating surface. The seating and contact surfaces should not be interrupted by grooves, holes or other recesses. The accuracy of mating parts must meet specific requirements ➤326|▦6 to ➤326|▦8.

Radial location of bearings – fit recommendations

For secure radial location, tight fits are necessary

In addition to supporting the rings adequately, the bearings must also be securely located in a radial direction, to prevent creep of the bearing rings on the mating parts under load. This is generally achieved by means of tight fits between the bearing rings and the mating parts. If the rings are not secured adequately or correctly, this can cause severe damage to the bearings and adjacent machine parts. Influencing factors, such as the conditions of rotation, magnitude of the load, internal clearance, temperature conditions, design of the mating parts and the mounting and dismounting options must be taken into consideration in the selection of fits.

If shock type loads occur, tight fits (transition fit or interference fit) are required to prevent the rings from coming loose at any point. Clearance, transition or interference fits ➤150|▦6 and ➤158|▦7.

The following information provided in Technical principles must be taken into consideration in the design of bearing arrangements:

- conditions of rotation ➤145
- tolerance classes for cylindrical shaft seats (radial bearings) ➤147|▦2
- shaft fits ➤150
- tolerance classes for bearing seats in housings (radial bearings) ➤148|▦4
- housing fits ➤158

Axial location of bearings – location methods

The bearings must also be securely located in an axial direction

As a tight fit alone is not normally sufficient to also locate the bearing rings securely on the shaft and in the housing bore in an axial direction, this must usually be achieved by means of an additional axial location or retention method. The axial location of the bearing rings must be matched to the type of bearing arrangement. Shaft and housing shoulders, housing covers, nuts, spacer rings and retaining rings etc., are fundamentally suitable.

Dimensional, geometrical and running accuracy of the bearing seats

For bearings with tolerance class Normal, a minimum of IT6 should be provided for the shaft seat and a minimum of IT7 for the housing seat

The accuracy of the bearing seat on the shaft and in the housing should correspond to the accuracy of the bearing used. For double row angular contact ball bearings with the tolerance class Normal, the shaft seat should correspond to a minimum of standard tolerance grade IT6 and the housing seat to a minimum of IT7; with tolerance class 6, the shaft seat should correspond to a minimum of IT5 and the housing seat to a minimum of IT6. Guide values for the geometrical and positional tolerances of bearing seating surfaces ➤326|▦6, tolerances t_1 to t_3 in accordance with ➤168|⧉11. Numerical values for IT grades ➤326|▦7.

6
Guide values for the geometrical and positional tolerances of bearing seating surfaces

Bearing tolerance class		Bearing seating surface	Standard tolerance grades to ISO 286-1 (IT grades)			
to ISO 492	to DIN 620		Diameter tolerance	Roundness tolerance t_1	Parallelism tolerance t_2	Total axial runout tolerance of abutment shoulder t_3
Normal	PN (P0)	Shaft	IT6 (IT5)	Circumferential load IT4/2	Circumferential load IT4/2	IT4
				Point load IT5/2	Point load IT5/2	
		Housing	IT7 (IT6)	Circumferential load IT5/2	Circumferential load IT5/2	IT5
				Point load IT6/2	Point load IT6/2	
6	P6	Shaft	IT5	Circumferential load IT3/2	Circumferential load IT3/2	IT3
				Point load IT4/2	Point load IT4/2	
		Housing	IT6	Circumferential load IT4/2	Circumferential load IT4/2	IT4
				Point load IT5/2	Point load IT5/2	

7
Numerical values for ISO standard tolerances (IT grades) to ISO 286-1:2010

IT grade	Nominal dimension in mm							
	over **3**	**6**	**10**	**18**	**30**	**50**	**80**	**120**
	incl. **6**	**10**	**18**	**30**	**50**	**80**	**120**	**180**
	Values in µm							
IT3	2,5	2,5	3	4	4	5	6	8
IT4	4	4	5	6	7	8	10	12
IT5	5	6	8	9	11	13	15	18
IT6	8	9	11	13	16	19	22	25
IT7	12	15	18	21	25	30	35	40

Roughness of cylindrical bearing seats

✎ *Ra must not be too high*

The roughness of the bearing seats must be matched to the tolerance class of the bearings. The mean roughness value Ra must not be too high, in order to maintain the interference loss within limits. The shafts must be ground, while the bores must be precision turned. Guide values as a function of the IT grade of bearing seating surfaces ➤ *326* | 8.

8
Roughness values for cylindrical bearing seating surfaces – guide values

Nominal diameter of the bearing seat d (D) mm		Recommended mean roughness value for ground bearing seats Ramax µm			
		Diameter tolerance (IT grade)			
over	incl.	IT7	IT6	IT5	IT4
–	80	1,6	0,8	0,4	0,2
80	500	1,6	1,6	0,8	0,4

Mounting dimensions for the contact surfaces of bearing rings

The contact surfaces for the rings must be of sufficient height

The mounting dimensions of the shaft and housing shoulders, and spacer rings etc., must ensure that the contact surfaces for the bearing rings are of sufficient height. However, they must also reliably prevent rotating parts of the bearing from grazing stationary parts. Proven mounting dimensions for the radii and diameters of abutment shoulders ➤ *330*. These dimensions are limiting dimensions (maximum or minimum dimensions); the actual values should not be higher or lower than specified.

2.17 Mounting and dismounting

The mounting and dismounting options for angular contact ball bearings, by thermal, hydraulic or mechanical methods, must be taken into consideration in the design of the bearing position.

Ensure that the bearings are not damaged during mounting

In the mounting of non-separable (self-retaining) angular contact ball bearings, the mounting forces must always be applied to the bearing ring with a tight fit.

Bearings with split inner ring

Simplified mounting of bearings due to split inner ring

These angular contact ball bearings are not self-retaining. As a result, the outer ring with the ball and cage assembly can be mounted separately from the two inner ring halves. This gives simplified mounting of the bearings.

Schaeffler Mounting Handbook

Rolling bearings must be handled with great care

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.

2.18 Legal notice regarding data freshness

The further development of products may also result in technical changes to catalogue products

Of central interest to Schaeffler is the further development and optimisation of its products and the satisfaction of its customers. In order that you, as the customer, can keep yourself optimally informed about the progress that is being made here and with regard to the current technical status of the products, we publish any product changes which differ from the printed version in our electronic product catalogue.

We therefore reserve the right to make changes to the data and illustrations in this catalogue. This catalogue reflects the status at the time of printing. More recent publications released by us (as printed or digital media) will automatically precede this catalogue if they involve the same subject. Therefore, please always use our electronic product catalogue to check whether more up-to-date information or modification notices exist for your desired product.

Link to electronic product catalogue

The following link will take you to the Schaeffler electronic product catalogue: ➤ *https://medias.schaeffler.com*.

2.19 Further information

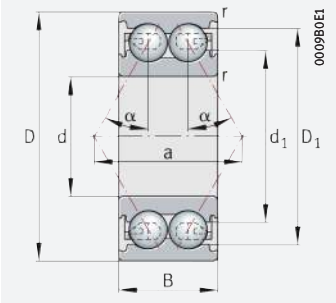
In addition to the data in this chapter, the following chapters in Technical principles must also be observed in the design of bearing arrangements:

- Determining the bearing size ➤34
- Rigidity ➤54
- Friction and increases in temperature ➤56
- Speeds ➤64
- Bearing data ➤97
- Lubrication ➤70
- Sealing ➤182
- Design of bearing arrangements ➤139
- Mounting and dismounting ➤191.

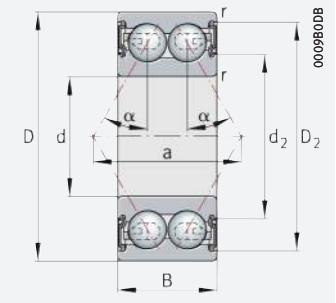
Angular contact ball bearings

Double row

d = 5 – 12 mm



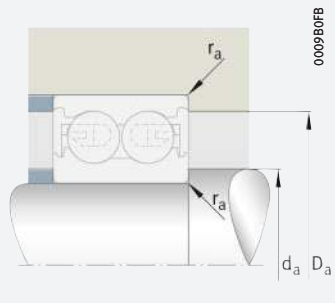
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33



38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RSR, 2RZ, 2Z

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤*322|2.12* ➤*322|2.13* X-life ➤*316*
			N	N	N	min^{-1}	min^{-1}	≈ kg	
5	14	7	1 780	940	47,5	51 000	31 500	0,005	**30/5-B-TVH**
	14	7	1 780	940	47,5	38 000	31 500	0,006	**30/5-B-2Z-TVH**
	14	7	1 780	940	47,5	30 500	–	0,006	**30/5-B-2RSR-TVH**
6	17	9	3 050	1 400	72	42 000	32 000	0,011	**30/6-B-TVH**
	17	9	3 050	1 400	72	31 500	32 000	0,011	**30/6-B-2Z-TVH**
	17	9	3 050	1 400	72	28 000	–	0,011	**30/6-B-2RSR-TVH**
7	19	10	3 650	1 690	86	39 500	31 500	0,01	**30/7-B-TVH**
	19	10	3 650	1 690	86	29 500	31 500	0,01	**30/7-B-2Z-TVH**
	19	10	3 650	1 690	86	25 500	–	0,01	**30/7-B-2RSR-TVH**
8	22	11	5 100	2 600	132	34 500	26 000	0,018	**30/8-B-TVH**
	22	11	5 100	2 600	132	26 000	26 000	0,018	**30/8-B-2Z-TVH**
	22	11	5 100	2 600	132	25 500	–	0,018	**30/8-B-2RSR-TVH**
10	19	7	2 080	1 370	70	40 500	21 000	0,008	**3800-B-TVH**
	19	7	2 080	1 370	70	30 500	21 000	0,008	**3800-B-2RZ-TVH**
	19	7	2 080	1 370	70	21 100	–	0,008	**3800-B-2RS-TVH**
	26	12	5 700	3 200	192	31 000	21 900	0,022	**3000-B-TVH**
	26	12	5 700	3 200	161	23 400	21 900	0,022	**3000-B-2RZ-TVH**
	26	12	5 700	3 200	161	18 100	–	0,022	**3000-B-2RS-TVH**
	30	14	7 800	4 450	226	21 100	21 000	0,052	**3200-B-TVH**
	30	14	7 800	4 450	226	21 100	21 000	0,05	**3200-B-2Z-TVH**
	30	14	7 800	4 450	226	16 100	–	0,053	**3200-B-2RS-TVH**
12	21	7	2 150	1 520	77	37 500	18 100	0,009	**3801-B-TVH**
	21	7	2 150	1 520	77	28 000	18 100	0,01	**3801-B-2RZ-TVH**
	21	7	2 150	1 520	77	17 500	–	0,01	**3801-B-2RS-TVH**
	28	12	6 100	3 700	188	29 500	19 300	0,025	**3001-B-TVH**
	28	12	6 100	3 700	188	22 000	19 300	0,032	**3001-B-2RZ-TVH**
	28	12	6 100	3 700	188	15 800	–	0,032	**3001-B-2RS-TVH**
	32	15,9	10 500	5 800	295	18 400	20 000	0,051	**3201-B-TVH**
	32	15,9	10 500	5 800	295	18 400	20 000	0,06	**3201-B-2Z-TVH**
	32	15,9	10 500	5 800	295	15 000	–	0,057	**3201-B-2RS-TVH**
	37	19	14 600	8 300	420	20 400	13 000	0,093	**3301-B-TVH**
	37	19	14 600	8 300	420	15 300	13 000	0,093	**3301-B-2Z-TVH**
	37	19	14 600	8 300	420	14 100	–	0,093	**3301-B-2RS-TVH**

medias ➤ *https://www.schaeffler.de/std/1D8D*

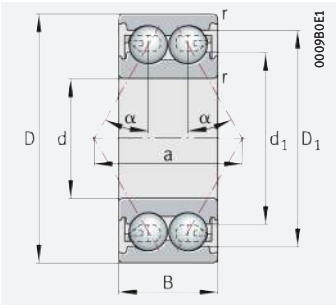


Mounting dimensions

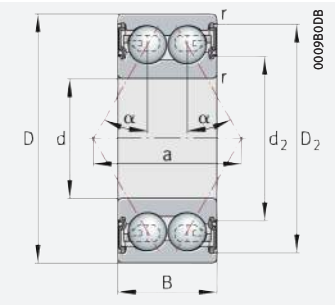
Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
5	0,2	11,2	–	8,8	–	6,9	25	6,4	12,6	0,2
	0,2	–	12,7	–	8,5	6,9	25	6,4	12,6	0,2
	0,2	–	12,7	–	8,5	6,9	25	6,4	12,6	0,2
6	0,3	13,4	–	9,6	–	8,8	25	8	15	0,3
	0,3	–	14,8	–	8,3	8,8	25	8	15	0,3
	0,3	–	14,8	–	8,3	8,8	25	8	15	0,3
7	0,3	14,6	–	10,4	–	9,6	25	9	17	0,3
	0,3	–	16,5	–	9	9,6	25	9	17	0,3
	0,3	–	16,5	–	9	9,6	25	9	17	0,3
8	0,3	17,6	–	12,6	–	11,2	25	10	20	0,3
	0,3	–	19	–	10,5	11,2	25	10	20	0,3
	0,3	–	19	–	10,5	11,2	25	10	20	0,3
10	0,3	15,9	–	13,3	–	9	25	12	17	0,3
	0,3	–	16,7	–	12,2	9	25	12	17	0,3
	0,3	–	16,7	–	12,2	9	25	12	17	0,3
	0,3	20,6	–	15,8	–	12,6	25	12	24	0,3
	0,3	–	21,2	–	14,2	12,6	25	12	24	0,3
	0,3	–	21,2	–	14,2	12,3	25	12	24	0,3
	0,6	23	–	16,6	–	14,79	25	14,2	25,8	0,6
	0,6	–	24,9	–	15,5	14,79	25	14,2	25,8	0,6
	0,6	–	24,9	–	15,5	14,79	25	14,2	25,8	0,6
12	0,3	18	–	15,3	–	9,9	25	14	19	0,3
	0,3	–	18,9	–	14,2	9,9	25	14	19	0,3
	0,3	–	18,9	–	14,2	9,9	25	14	19	0,3
	0,3	22,5	–	17,6	–	13,5	25	14	26	0,3
	0,3	–	23,2	–	16,4	13,5	25	14	26	0,3
	0,3	–	23,2	–	16,4	13,5	25	14	26	0,3
	0,6	26	–	17,8	–	16,53	25	16,2	27,8	0,6
	0,6	–	27,8	–	17,1	16,53	25	16,2	27,8	0,6
	0,6	–	27,8	–	17,1	16,53	25	16,2	27,8	0,6
	1	30,5	–	21,7	–	19,8	25	17,6	31,4	1
	1	–	32,1	–	18,7	19,8	25	17,6	31,4	1
	1	–	32,1	–	18,7	19,8	25	17,6	31,4	1

Angular contact ball bearings

Double row



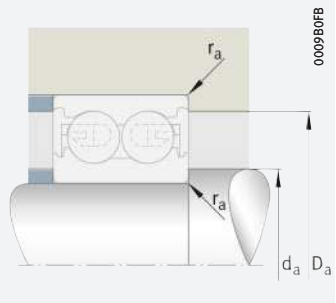
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33



38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RSR, 2RZ, 2Z

d = 15 – 17 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤322|2.12 ➤322|2.13 X-life ➤316
			N	N	N	min^{-1}	min^{-1}	≈ kg	
15	24	7	2 080	1 560	79	33 500	14 900	0,01	**3802-B-TVH**
	24	7	2 080	1 560	79	25 000	14 900	0,012	**3802-B-2RZ-TVH**
	24	7	2 080	1 560	79	14 600	–	0,012	**3802-B-2RS-TVH**
	32	13	8 500	5 400	280	23 900	15 700	0,042	**3002-B-TVH**
	32	13	8 500	5 400	280	17 900	15 700	0,05	**3002-B-2RZ-TVH**
	32	13	8 500	5 400	280	13 000	–	0,05	**3002-B-2RS-TVH**
	35	15,9	12 600	7 400	500	22 300	18 500	0,066	**3202-BD-XL-TVH**
	35	15,9	12 600	7 400	500	16 700	18 500	0,065	**3202-BD-XL-2Z-TVH**
	35	15,9	12 600	7 400	500	16 700	–	0,065	**3202-BD-XL-2HRS-TVH**
	42	19	17 000	10 400	700	18 400	12 100	0,124	**3302-BD-XL-TVH**
	42	19	17 000	10 400	700	13 800	12 100	0,122	**3302-BD-XL-2Z-TVH**
	42	19	17 000	10 400	700	13 800	–	0,122	**3302-BD-XL-2HRS-TVH**
17	26	7	2 430	2 020	105	30 500	13 200	0,011	**3803-B-TVH**
	26	7	2 430	2 020	105	23 000	13 200	0,013	**3803-B-2RZ-TVH**
	26	7	2 430	2 020	105	13 200	–	0,013	**3803-B-2RS-TVH**
	35	14	9 100	6 100	305	22 500	15 300	0,042	**3003-B-TVH**
	35	14	9 100	6 100	305	16 800	15 300	0,057	**3003-B-2RZ-TVH**
	35	14	9 100	6 100	305	12 300	–	0,055	**3003-B-2RS-TVH**
	40	17,5	15 500	9 500	640	19 400	16 600	0,095	**3203-BD-XL-TVH**
	40	17,5	15 500	9 500	640	14 600	16 600	0,094	**3203-BD-XL-2Z-TVH**
	40	17,5	15 500	9 500	640	14 600	–	0,093	**3203-BD-XL-2HRS-TVH**
	47	22,2	22 500	13 100	880	16 600	12 600	0,177	**3303-BD-XL-TVH**
	47	22,2	22 500	13 100	880	12 400	12 600	0,176	**3303-BD-XL-2Z-TVH**
	47	22,2	22 500	13 100	880	12 400	–	0,176	**3303-BD-XL-2HRS-TVH**

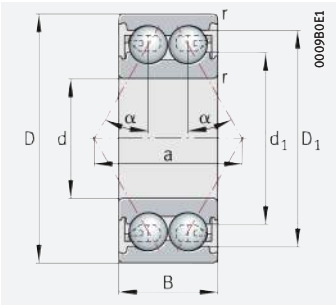


Mounting dimensions

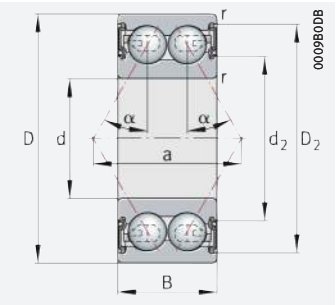
Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
15	0,3	20,9	–	18,3	–	11,3	25	17	22	0,3
	0,3	–	21,8	–	17,2	11,3	25	17	22	0,3
	0,3	–	21,8	–	17,2	11,3	25	17	22	0,3
	0,3	27,2	–	21,3	–	18,4	25	17	30	0,3
	0,3	–	27,9	–	19,7	18,4	25	17	30	0,3
	0,3	–	27,9	–	19,7	18,4	25	17	30	0,3
	0,6	29,4	–	22,2	–	20,7	30	19,2	30,8	0,6
	0,6	–	31,1	–	21	20,7	30	19,2	30,8	0,6
	0,6	–	31,1	–	21	20,7	30	19,2	30,8	0,6
	1	35,7	–	27,2	–	24,8	30	20,6	36,4	1
	1	–	37,9	–	25,8	24,8	30	20,6	36,4	1
	1	–	37,9	–	25,8	24,8	30	20,6	36,4	1
17	0,3	22,9	–	20,3	–	12,3	25	19	24	0,3
	0,3	–	23,8	–	19,2	12,3	25	19	24	0,3
	0,3	–	23,8	–	19,2	12,3	25	19	24	0,3
	0,3	29,1	–	23,1	–	17,1	25	19	33	0,3
	0,3	–	29,8	–	21	17,1	25	19	33	0,3
	0,3	–	29,8	–	21	17,1	25	19	33	0,3
	0,6	33,9	–	25,8	–	23,5	30	21,2	35,8	0,6
	0,6	–	36,1	–	24,4	23,5	30	21,2	35,8	0,6
	0,6	–	36,1	–	24,4	23,5	30	21,2	35,8	0,6
	1	39	–	28,5	–	27,5	30	22,6	41,4	1
	1	–	41,1	–	27,1	27,5	30	22,6	41,4	1
	1	–	41,1	–	27,1	27,5	30	22,6	41,4	1

Angular contact ball bearings

Double row



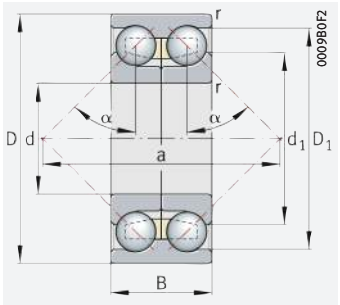
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33



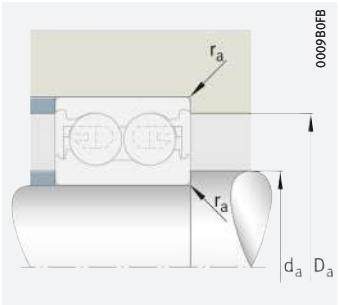
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RSR, 2RZ, 2Z

d = 20 – 25 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤322|2.12 ➤322|2.13 X-life ➤316
			N	N	N	min^{-1}	min^{-1}	≈ kg	
20	32	10	5 600	4 750	240	23 200	11 800	0,024	**3804-B-TVH**
	32	10	5 600	4 750	240	17 400	11 800	0,026	**3804-B-2RZ-TVH**
	32	10	5 600	4 750	240	10 700	–	0,026	**3804-B-2RS-TVH**
	42	16	14 300	9 400	475	18 100	13 200	0,08	**3004-B-TVH**
	42	16	14 300	9 400	475	13 600	13 200	0,094	**3004-B-2RZ-TVH**
	42	16	14 300	9 400	475	10 500	–	0,094	**3004-B-2RS-TVH**
	47	20,6	20 600	12 900	870	16 100	14 700	0,154	**3204-BD-XL-TVH**
	47	20,6	20 600	12 900	870	12 100	14 700	0,153	**3204-BD-XL-2Z-TVH**
	47	20,6	20 600	12 900	870	12 100	–	0,149	**3204-BD-XL-2HRS-TVH**
	52	22,2	24 600	15 900	1 070	14 700	10 400	0,215	**3304-BD-XL-TVH**
	52	22,2	24 600	15 900	1 070	11 000	10 400	0,214	**3304-BD-XL-2Z-TVH**
	52	22,2	24 600	15 900	1 070	11 000	–	0,217	**3304-BD-XL-2HRS-TVH**
25	37	10	5 900	5 500	275	20 400	10 300	0,034	**3805-B-TVH**
	37	10	5 900	5 500	275	15 300	10 300	0,036	**3805-B-2RZ-TVH**
	37	10	5 900	5 500	275	9 300	–	0,036	**3805-B-2RS-TVH**
	47	16	15 200	10 900	550	15 900	11 100	0,1	**3005-B-TVH**
	47	16	15 200	10 900	550	11 900	11 100	0,1	**3005-B-2RZ-TVH**
	47	16	15 200	10 900	550	8 800	–	0,1	**3005-B-2RS-TVH**
	52	20,6	22 000	15 200	1 020	14 300	12 500	0,174	**3205-BD-XL-TVH**
	52	20,6	22 000	15 200	1 020	10 700	12 500	0,175	**3205-BD-XL-2Z-TVH**
	52	20,6	22 000	15 200	1 020	10 700	–	0,176	**3205-BD-XL-2HRS-TVH**
	62	25,4	30 000	23 200	1 400	13 100	8 400	0,341	**3305-DA-TVP**
	62	25,4	31 500	21 000	1 410	12 400	9 400	0,352	**3305-BD-XL-TVH**
	62	25,4	31 500	21 000	1 410	9 300	9 400	0,348	**3305-BD-XL-2Z-TVH**
	62	25,4	31 500	21 000	1 410	9 300	–	0,352	**3305-BD-XL-2HRS-TVH**



33..-DA;
split inner ring

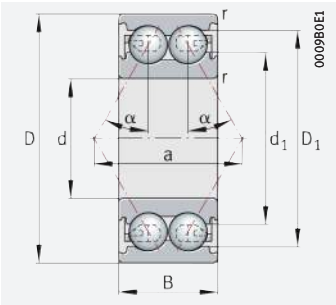


Mounting dimensions

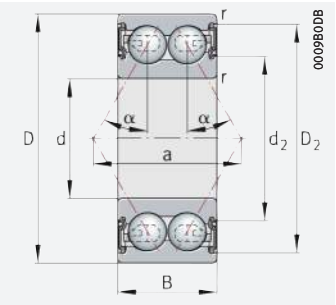
Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
20	0,3	29,2	–	25,1	–	16,1	25	22	30	0,3
	0,3	–	30,1	–	23,9	16,1	25	22	30	0,3
	0,3	–	30,1	–	23,9	16,1	25	22	30	0,3
	0,6	35	–	27,1	–	21,1	25	23,2	38,8	0,6
	0,6	–	36,4	–	25,3	21,1	25	23,2	38,8	0,6
	0,6	–	36,4	–	25,3	21,1	25	23,2	38,8	0,6
	1	40,1	–	30,8	–	27,9	30	25,6	41,4	1
	1	–	42,2	–	29,2	27,9	30	25,6	41,4	1
	1	–	42,2	–	29,2	27,9	30	25,6	41,4	1
	1,1	44	–	33,5	–	30,4	30	27	45	1
	1,1	–	46,1	–	31,9	30,4	30	27	45	1
	1,1	–	46,1	–	31,9	30,4	30	27	45	1
25	0,3	33,2	–	29,1	–	17,9	25	27	35	0,3
	0,3	–	34,1	–	27,9	17,9	25	27	35	0,3
	0,3	–	34,1	–	27,9	17,9	25	27	35	0,3
	0,6	40,1	–	32,1	–	23,4	25	28,2	43,8	0,6
	0,6	–	41,8	–	30,3	23,4	25	28,2	43,8	0,6
	0,6	–	41,8	–	30,3	23,4	25	28,2	43,8	0,6
	1	45,1	–	35,8	–	30,8	30	30,6	46,4	1
	1	–	47,6	–	34,2	30,8	30	30,6	46,4	1
	1	–	47,6	–	34,2	30,8	30	30,6	46,4	1
	1,1	51,8	–	41	–	56	45	32	55	1
	1,1	51,5	–	39,5	–	35,4	30	32	55	1
	1,1	–	53,7	–	37,6	35,4	30	32	55	1
	1,1	–	53,7	–	37,6	35,4	30	32	55	1

Angular contact ball bearings

Double row



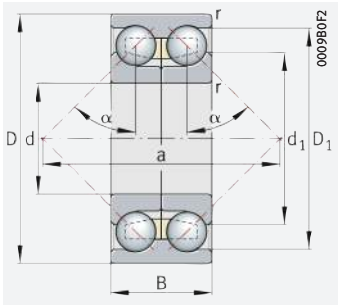
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33



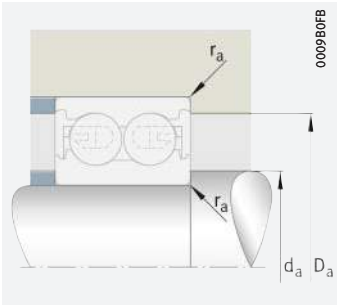
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RSR, 2RZ, 2Z

d = 30 – 35 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤322|2.12 ➤322|2.13 X-life ➤316
			N	N	N	min^{-1}	min^{-1}	≈ kg	
30	42	10	6 100	6 000	315	17 700	8 700	0,035	**3806-B-TVH**
	42	10	6 100	6 000	315	13 300	8 700	0,037	**3806-B-2RZ-TVH**
	42	10	6 100	6 000	315	8 100	–	0,037	**3806-B-2RS-TVH**
	55	19	19 900	15 400	780	13 500	10 100	0,16	**3006-B-TVH**
	55	19	19 900	15 400	780	10 100	10 100	0,16	**3006-B-2RZ-TVH**
	55	19	19 900	15 400	780	7 400	–	0,16	**3006-B-2RS-TVH**
	62	23,8	31 000	22 200	1 490	11 900	11 100	0,288	**3206-BD-XL-TVH**
	62	23,8	31 000	22 200	1 490	9 000	11 100	0,283	**3206-BD-XL-2Z-TVH**
	62	23,8	31 000	22 200	1 490	9 000	–	0,29	**3206-BD-XL-2HRS-TVH**
	72	30,2	41 500	34 500	1 820	10 900	7 500	0,657	**3306-DA**
	72	30,2	43 000	29 500	1 990	10 400	8 500	0,543	**3306-BD-XL-TVH**
	72	30,2	43 000	29 500	1 990	7 800	8 500	0,54	**3306-BD-XL-2Z-TVH**
	72	30,2	43 000	29 500	1 990	7 800	–	0,549	**3306-BD-XL-2HRS-TVH**
35	47	10	6 500	6 800	365	15 500	7 400	0,039	**3807-B-TVH**
	47	10	6 500	6 800	365	11 700	7 400	0,041	**3807-B-2RZ-TVH**
	47	10	6 500	6 800	365	7 000	–	0,041	**3807-B-2RS-TVH**
	62	20	24 000	19 100	970	11 700	8 800	0,2	**3007-B-TVH**
	62	20	24 000	19 100	970	8 800	8 800	0,224	**3007-B-2RZ-TVH**
	62	20	24 000	19 100	970	6 400	–	0,224	**3007-B-2RS-TVH**
	72	27	41 000	30 000	2 030	10 100	9 900	0,436	**3207-BD-XL-TVH**
	72	27	41 000	30 000	2 030	7 600	9 900	0,432	**3207-BD-XL-2Z-TVH**
	72	27	41 000	30 000	2 030	7 600	–	0,44	**3207-BD-XL-2HRS-TVH**
	80	34,9	50 000	41 000	2 600	9 600	7 100	0,889	**3307-DA**
	80	34,9	55 000	36 500	2 460	9 000	8 100	0,706	**3307-BD-XL-TVH**
	80	34,9	55 000	36 500	2 460	6 800	8 100	0,702	**3307-BD-XL-2Z-TVH**
	80	34,9	55 000	36 500	2 460	6 800	–	0,717	**3307-BD-XL-2HRS-TVH**



33..-DA;
split inner ring



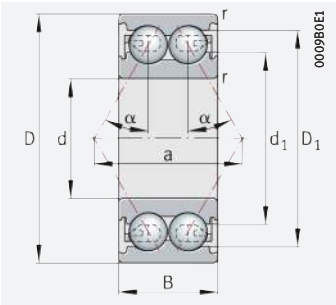
Mounting dimensions

Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
30	0,3	38	–	34	–	20,2	25	32	40	0,3
	0,3	–	39	–	32,9	20,2	25	32	40	0,3
	0,3	–	39	–	32,9	20,2	25	32	40	0,3
	1	46,7	–	37,3	–	27,4	25	34,6	50,4	1
	1	–	49,1	–	35,6	27,4	25	34,6	50,4	1
	1	–	49,1	–	35,6	27,4	25	34,6	50,4	1
	1	53,3	–	42,2	–	36,4	30	35,6	56,4	1
	1	–	55,8	–	40,3	36,4	30	35,6	56,4	1
	1	–	55,8	–	40,3	36,4	30	35,6	56,4	1
	1,1	61,5	–	48,2	–	67	45	37	65	1
	1,1	60,5	–	46,3	–	41,9	30	37	65	1
	1,1	–	63,5	–	44,4	41,9	30	37	65	1
	1,1	–	63,5	–	44,4	41,9	30	37	65	1
35	0,3	43	–	39	–	22,6	25	37	45	0,3
	0,3	–	44,1	–	37,6	22,6	25	37	45	0,3
	0,3	–	44,1	–	37,6	22,6	25	37	45	0,3
	1	53,3	–	43,7	–	30,9	25	39,6	57,4	1
	1	–	55,3	–	40,5	30,9	25	39,6	57,4	1
	1	–	55,3	–	40,5	30,9	25	39,6	57,4	1
	1,1	62,4	–	49,1	–	42,5	30	42	65	1
	1,1	–	65,4	–	46,9	42,5	30	42	65	1
	1,1	–	65,4	–	46,9	42,5	30	42	65	1
	1,5	69,5	–	55,2	–	75	45	44	71	1,5
	1,5	68,9	–	51,8	–	48	30	44	71	1,5
	1,5	–	71,9	–	49,6	48	30	44	71	1,5
	1,5	–	71,9	–	49,6	48	30	44	71	1,5

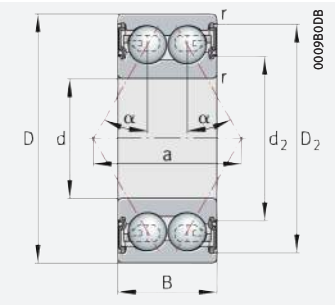
Angular contact ball bearings

Double row

d = 40 – 50 mm

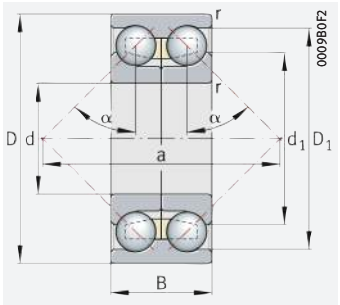


38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33

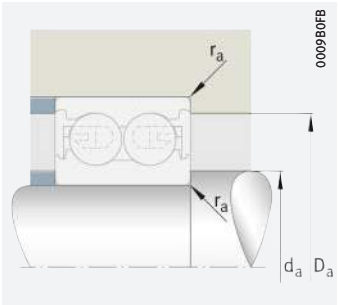


38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RSR, 2RZ, 2Z

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤*322|2.12* ➤*322|2.13* X-life ➤*316*
			N	N	N	min^{-1}	min^{-1}	≈ kg	
40	52	10	6 900	7 600	415	13 700	6 300	0,044	**3808-B-TVH**
	52	10	6 900	7 600	415	10 300	6 300	0,046	**3808-B-2RZ-TVH**
	52	10	6 900	7 600	415	6 100	–	0,046	**3808-B-2RS-TVH**
	68	21	25 000	21 300	1 080	10 600	8 000	0,25	**3008-B-TVH**
	68	21	25 000	21 300	1 080	8 000	8 000	0,25	**3008-B-2RZ-TVH**
	68	21	25 000	21 300	1 080	5 600	–	0,25	**3008-B-2RS-TVH**
	80	30,2	51 000	38 000	2 550	8 900	9 100	0,591	**3208-BD-XL-TVH**
	80	30,2	51 000	38 000	2 550	6 700	9 100	0,58	**3208-BD-XL-2Z-TVH**
	80	30,2	51 000	38 000	2 550	6 700	–	0,597	**3208-BD-XL-2HRS-TVH**
	90	36,5	62 000	52 000	3 250	10 700	6 000	1,2	**3308-DA-MA**
	90	36,5	67 000	48 500	3 250	8 000	7 000	0,969	**3308-BD-XL-TVH**
	90	36,5	67 000	48 500	3 250	6 000	7 000	0,967	**3308-BD-XL-2Z-TVH**
	90	36,5	67 000	48 500	3 250	6 000	–	0,985	**3308-BD-XL-2HRS-TVH**
45	58	10	7 000	8 100	455	12 400	5 700	0,055	**3809-B-TVH**
	58	10	7 000	8 100	455	9 300	5 700	0,058	**3809-B-2RZ-TVH**
	58	10	7 000	8 100	455	5 500	–	0,058	**3809-B-2RS-TVH**
	85	30,2	50 000	39 000	2 650	8 300	8 400	0,622	**3209-BD-XL-TVH**
	85	30,2	50 000	39 000	2 650	6 300	8 400	0,618	**3209-BD-XL-2Z-TVH**
	85	30,2	50 000	39 000	2 650	6 300	–	0,626	**3209-BD-XL-2HRS-TVH**
	100	39,7	71 000	64 000	3 500	7 500	5 800	1,55	**3309-DA**
	100	39,7	72 000	54 000	3 600	7 300	6 700	1,335	**3309-BD-XL-TVH**
	100	39,7	72 000	54 000	3 600	5 500	6 700	1,315	**3309-BD-XL-2Z-TVH**
	100	39,7	72 000	54 000	3 600	5 500	–	1,314	**3309-BD-XL-2HRS-TVH**
50	65	12	8 500	10 200	570	10 900	5 400	0,09	**3810-B-TVH**
	65	12	8 500	10 200	570	8 100	5 400	0,093	**3810-B-2RZ-TVH**
	65	12	8 500	10 200	570	4 800	–	0,093	**3810-B-2RS-TVH**
	90	30,2	53 000	44 000	3 000	7 800	7 600	0,672	**3210-BD-XL-TVH**
	90	30,2	53 000	44 000	3 000	5 900	7 600	0,667	**3210-BD-XL-2Z-TVH**
	90	30,2	53 000	44 000	3 000	5 900	–	0,668	**3210-BD-XL-2HRS-TVH**
	110	44,4	90 000	84 000	5 200	8 700	5 300	2,24	**3310-DA-MA**
	110	44,4	93 000	70 000	4 700	6 500	6 300	1,749	**3310-BD-XL-TVH**
	110	44,4	93 000	70 000	4 700	4 900	6 300	1,75	**3310-BD-XL-2Z-TVH**
	110	44,4	93 000	70 000	4 700	4 900	–	1,748	**3310-BD-XL-2HRS-TVH**



33..-DA;
split inner ring

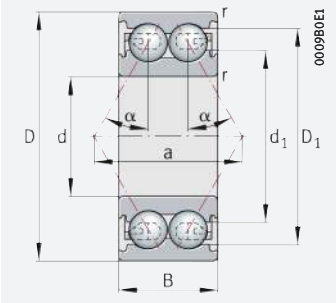


Mounting dimensions

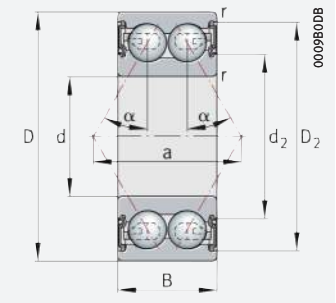
Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
40	0,3	48,5	–	44,6	–	25,2	25	42	50	0,3
	0,3	–	49,6	–	43,5	25,2	25	42	50	0,3
	0,3	–	49,6	–	43,5	25,2	25	42	50	0,3
	1	58,8	–	49,2	–	33,4	25	44,6	63,4	1
	1	–	61,2	–	46,7	33,4	25	44,6	63,4	1
	1	–	61,2	–	46,7	33,4	25	44,6	63,4	1
	1,1	69,6	–	54,9	–	47,4	30	47	73	1
	1,1	–	72,6	–	52,8	47,4	30	47	73	1
	1,1	–	72,6	–	52,8	47,4	30	47	73	1
	1,5	79,7	–	61,7	–	85	45	49	81	1,5
	1,5	77	–	59	–	53,1	30	49	81	1,5
	1,5	–	79,9	–	56,8	53,1	30	49	81	1,5
	1,5	–	79,9	–	56,8	53,1	30	49	81	1,5
45	0,3	53,6	–	49,6	–	27,5	25	47	56	0,3
	0,3	–	54,6	–	48,1	27,5	25	47	56	0,3
	0,3	–	54,6	–	48,1	27,5	25	47	56	0,3
	1,1	75,1	–	59,9	–	50,3	30	52	78	1
	1,1	–	78,1	–	57,7	50,3	30	52	78	1
	1,1	–	78,1	–	57,7	50,3	30	52	78	1
	1,5	86,7	–	68,3	–	93	45	54	91	1,5
	1,5	84,4	–	65,5	–	57,8	30	54	91	1,5
	1,5	–	87,3	–	63,3	57,8	30	54	91	1,5
	1,5	–	87,3	–	63,3	57,8	30	54	91	1,5
50	0,3	60,7	–	56,3	–	31	25	52	63	0,3
	0,3	–	61,7	–	55,2	31	25	52	63	0,3
	0,3	–	61,7	–	55,2	31	25	52	63	0,3
	1,1	80,1	–	64,9	–	53,2	30	57	83	1
	1,1	–	82,9	–	62,8	53,2	30	57	83	1
	1,1	–	82,9	–	62,8	53,2	30	57	83	1
	2	96,9	–	77,3	–	104	45	61	99	2
	2	93,3	–	71,5	–	64,2	30	61	99	2
	2	–	96,8	–	69,1	64,2	30	61	99	2
	2	–	96,8	–	69,1	64,2	30	61	99	2

Angular contact ball bearings

Double row



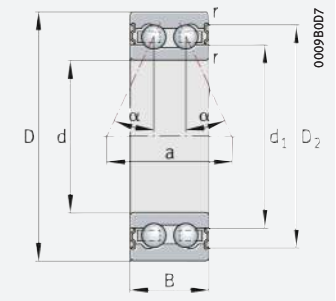
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33



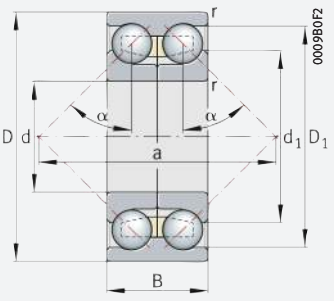
38..-B, 30..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RZ, 2Z

d = 55 – 65 mm

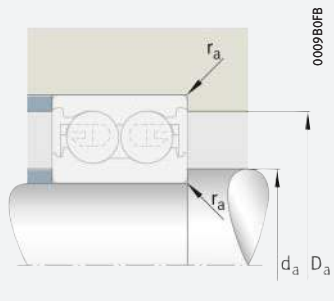
Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤322|2.12 ➤322|2.13 X-life ➤316
			N	N	N	min^{-1}	min^{-1}	≈ kg	
55	72	13	10 700	13 100	730	9 600	4 850	0,13	**3811-B-TVH**
	72	13	10 700	13 100	730	7 200	4 850	0,134	**3811-B-2RZ-TVH**
	72	13	10 700	13 100	730	4 300	–	0,134	**3811-B-2RS-TVH**
	100	33,3	61 000	51 000	3 450	7 100	7 200	0,94	**3211-BD-XL-TVH**
	100	33,3	61 000	51 000	3 450	5 300	7 200	0,93	**3211-BD-XL-2Z-TVH**
	100	33,3	61 000	51 000	3 450	5 300	–	0,933	**3211-BD-XL-2HRS-TVH**
	120	49,2	105 000	101 000	5 400	8 000	5 200	2,85	**3311-DA-MA**
	120	49,2	116 000	88 000	6 000	5 800	5 900	2,28	**3311-BD-XL-TVH**
	120	49,2	116 000	88 000	6 000	4 350	5 900	2,265	**3311-BD-XL-2Z-TVH**
	120	49,2	116 000	88 000	6 000	4 350	–	2,264	**3311-BD-XL-2HRS-TVH**
60	78	14	14 200	17 100	940	8 800	4 700	0,161	**3812-B-TVH**
	78	14	14 200	17 100	940	6 600	4 700	0,166	**3812-B-2RZ-TVH**
	78	14	14 200	17 100	940	4 050	–	0,166	**3812-B-2RS-TVH**
	110	36,5	75 000	64 000	4 300	6 300	6 700	1,25	**3212-BD-XL-TVH**
	110	36,5	75 000	64 000	4 300	4 750	6 700	1,24	**3212-BD-XL-2Z-TVH**
	110	36,5	75 000	64 000	4 300	4 750	–	1,25	**3212-BD-XL-2HRS-TVH**
	130	54	121 000	118 000	6 500	5 500	4 850	3,39	**3312-DA**
	130	54	126 000	103 000	5 200	3 950	5 000	2,85	**3312-B-TVH**
	130	54	126 000	103 000	5 200	3 950	5 000	2,92	**3312-B-2Z-TVH**
	130	54	126 000	103 000	5 200	3 300	–	2,92	**3312-B-2RSR-TVH**
65	120	38,1	86 000	77 000	5 200	5 700	6 000	1,604	**3213-BD-XL-TVH**
	120	38,1	86 000	77 000	5 200	4 300	6 000	1,602	**3213-BD-XL-2Z-TVH**
	120	38,1	86 000	77 000	5 200	4 300	–	1,6	**3213-BD-XL-2HRS-TVH**
	140	58,7	139 000	137 000	7 200	5 100	4 650	4,384	**3313-DA**
	140	58,7	150 000	119 000	7 900	4 900	5 300	4,1	**3313-BD-XL-TVH**
	140	58,7	150 000	119 000	7 900	3 650	5 300	4,1	**3313-BD-XL-2Z-TVH**



32..-B, 33..-B;
with seal 2RSR, 2Z



33..-DA;
split inner ring



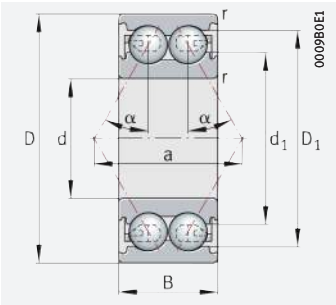
Mounting dimensions

Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
55	0,3	68	–	63,1	–	34,9	25	57	70	0,3
	0,3	–	69,1	–	61,4	34,9	25	57	70	0,3
	0,3	–	69,1	–	61,4	34,9	25	57	70	0,3
	1,5	87,8	–	71,6	–	58,4	30	64	91	1,5
	1,5	–	90,8	–	69,2	58,4	30	64	91	1,5
	1,5	–	90,8	–	69,2	58,4	30	64	91	1,5
	2	105,3	–	81,6	–	111	45	66	109	2
	2	103,3	–	78,8	–	71,4	30	66	109	2
	2	–	106,8	–	76,4	71,4	30	66	109	2
	2	–	106,8	–	76,4	71,4	30	66	109	2
60	0,3	73	–	67,1	–	38,1	25	62	76	0,3
	0,3	–	74,8	–	67,3	38,1	25	62	76	0,3
	0,3	–	74,8	–	67,3	38,1	25	62	76	0,3
	1,5	97	–	79	–	64,7	30	69	101	1,5
	1,5	–	100,5	–	76,6	64,7	30	69	101	1,5
	1,5	–	100,5	–	76,6	64,7	30	69	101	1,5
	2,1	115,8	–	91,9	–	122	45	72	118	2,1
	2,1	108,7	–	81,6	–	67,3	25	72	118	2,1
	2,1	–	113,1	81,25	–	67,3	25	72	118	2,1
	2,1	–	113,1	81,25	–	67,3	25	72	118	2,1
65	1,5	106,6	–	87,7	–	70,6	30	74	111	1,5
	1,5	–	110,1	–	85,3	70,6	30	74	111	1,5
	1,5	–	110,1	–	85,3	70,6	30	74	111	1,5
	2,1	124,1	–	98,4	–	131	45	77	128	2,1
	2,1	120,5	–	93,4	–	83,49	30	77	128	2,1
	2,1	–	125	–	90,6	83,49	30	77	128	2,1

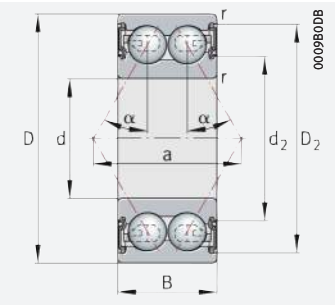
Angular contact ball bearings

Double row

d = 70 – 85 mm

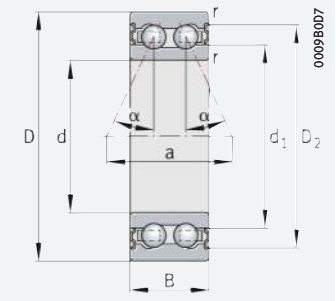


38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33

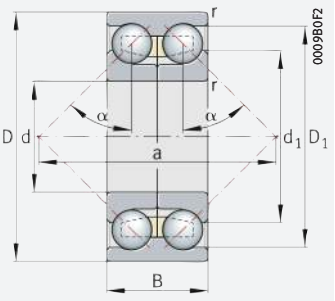


38..-B, 30..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RZ, 2Z

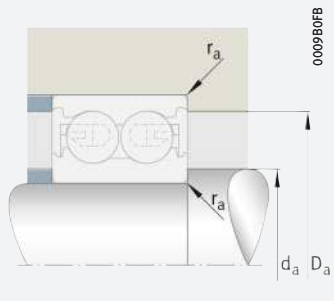
Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤322|2.12 ➤322|2.13 X-life ➤316
			N	N	N	min^{-1}	min^{-1}	≈ kg	
70	90	15	18 800	23 200	1 280	7 500	4 050	0,2	**3814-B-TVH**
	90	15	18 800	23 200	1 280	5 700	4 050	0,205	**3814-B-2RZ-TVH**
	90	15	18 800	23 200	1 280	3 450	–	0,205	**3814-B-2RS-TVH**
	125	39,7	82 000	79 000	4 000	4 150	5 600	1,78	**3214-B-TVH**
	125	39,7	82 000	79 000	4 000	4 150	5 600	1,78	**3214-B-2Z-TVH**
	125	39,7	82 000	79 000	4 000	3 100	–	1,78	**3214-B-2RSR-TVH**
	150	63,5	157 000	157 000	8 200	4 800	4 550	5,359	**3314-DA**
	150	63,5	172 000	135 000	8 700	4 550	5 100	4,499	**3314-BD-XL-TVH**
	150	63,5	172 000	135 000	8 700	3 400	5 100	4,5	**3314-BD-XL-2Z-TVH**
	150	63,5	167 000	176 000	8 500	4 750	4 500	4,89	**3314**
75	130	41,3	88 000	85 000	4 250	3 900	5 300	1,907	**3215-B-TVH**
	130	41,3	88 000	85 000	4 250	3 900	5 300	1,94	**3215-B-2Z-TVH**
	130	41,3	88 000	85 000	4 250	2 900	–	1,939	**3215-B-2RSR-TVH**
	160	68,3	184 000	179 000	10 000	5 800	4 350	5,904	**3315-DA-MA**
	160	68,3	192 000	209 000	9 700	4 400	4 250	6,16	**3315**
80	100	15	19 200	24 800	1 390	6 800	3 650	0,22	**3816-B-TVH**
	100	15	19 200	24 800	1 390	5 100	3 650	0,23	**3816-B-2RZ-TVH**
	100	15	19 200	24 800	1 390	3 100	–	0,23	**3816-B-2RS-TVH**
	140	44,4	99 000	102 000	4 950	3 650	5 100	2,403	**3216-B-TVH**
	140	44,4	99 000	102 000	4 950	3 650	5 100	2,48	**3216-B-2Z-TVH**
	140	44,4	99 000	102 000	4 950	2 700	–	2,48	**3216-B-2RSR-TVH**
	170	68,3	192 000	196 000	9 600	5 400	3 900	7,879	**3316-DA-MA**
	170	68,3	199 000	180 000	10 700	3 950	4 300	6,4	**3316-BD-XL-TVH**
	170	68,3	199 000	180 000	10 700	2 950	–	6,3	**3316-BD-XL-2HRS-TVH**
	170	68,3	208 000	226 000	10 300	4 150	3 900	6,785	**3316**
85	150	49,2	135 000	127 000	5 900	3 350	4 900	3	**3217-B-TVH**
	150	49,2	135 000	127 000	5 900	3 350	4 900	3,3	**3217-B-2Z-TVH**
	150	49,2	135 000	127 000	5 900	2 600	–	3,3	**3217-B-2RS-TVH**
	150	49,2	128 000	154 000	7 200	4 650	4 700	3,32	**3217**
	180	73	229 000	255 000	11 100	5 000	3 600	8,46	**3317-M**
	180	73	209 000	221 000	10 700	5 200	3 750	9,39	**3317-DA-MA**



32..-B, 33..-B;
with seal 2RSR, 2Z



33..-DA;
split inner ring

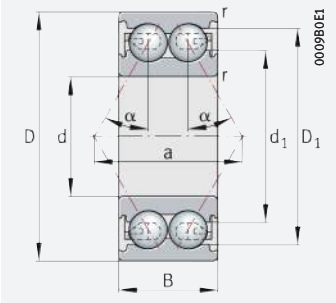


Mounting dimensions

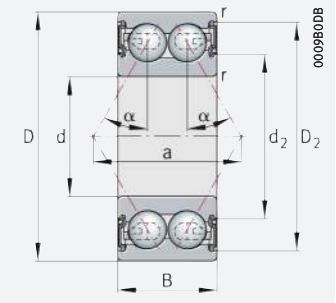
Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
70	0,6	84,5	–	77,7	–	43,6	25	73,2	86,8	0,6
	0,6	–	86,3	–	76,6	43,6	25	73,2	86,8	0,6
	0,6	–	86,3	–	76,6	43,6	25	73,2	86,8	0,6
	1,5	106,3	–	87	–	61,6	25	79	116	1,5
	1,5	–	110,7	86,8	–	61,6	25	79	116	1,5
	1,5	–	110,7	86,8	–	61,6	25	79	116	1,5
	2,1	132,4	–	103,4	–	141	45	82	138	2,1
	2,1	129,2	–	100,3	–	89,409	30	82	138	2,1
	2,1	–	133,7	–	96,9	89,409	30	82	138	2,1
	2,1	131,9	–	98,5	–	109,02	35	82	138	2,1
75	1,5	112,6	–	92,4	–	65,2	25	84	121	1,5
	1,5	–	115,5	92,1	–	65,2	25	84	121	1,5
	1,5	–	115,5	92,1	–	65,2	25	84	121	1,5
	2,1	141,3	–	109,3	–	150	45	87	148	2,1
	2,1	141,2	–	105,5	–	116,6	35	87	148	2,1
80	0,6	93,5	–	86,7	–	47,8	25	83,2	96,8	0,6
	0,6	–	95,3	–	85,5	47,8	25	83,2	96,8	0,6
	0,6	–	95,3	–	85,5	47,8	25	83,2	96,8	0,6
	2	120,3	–	98,8	–	69,13	25	91	129	2
	2	–	124,5	98,5	–	69,13	25	91	129	2
	2	–	124,5	98,5	–	69,13	25	91	129	2
	2,1	149,9	–	118,7	–	159	45	92	158	2,1
	2,1	148	–	116,7	–	100,8	30	92	158	2,1
	2,1	–	151,9	–	114	100,8	30	92	158	2,1
	2,1	149,7	–	111,8	–	122,53	35	92	158	2,1
85	2	130,4	–	105	–	75,9	25	96	139	2
	2	–	135,1	–	102,3	75,9	25	96	139	2
	2	–	135,1	–	102,3	75,9	25	96	139	2
	2	135,1	–	108,5	–	106,3	35	96	139	2
	3	160	–	119,6	–	131,48	35	99	166	2,5
	3	156,5	–	124,3	–	167	45	99	166	2,5

Angular contact ball bearings

Double row



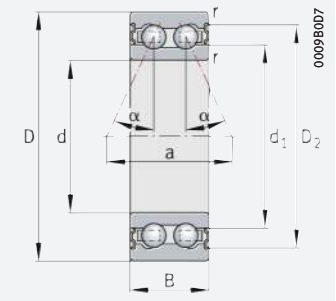
38..-B, 30..-B, 32..-B, 33..-B, 32..-BD, 33..-BD, 32, 33



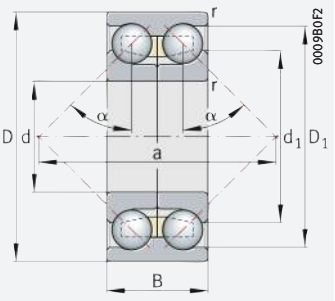
38..-B, 30..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RZ, 2Z

d = 90 – 110 mm

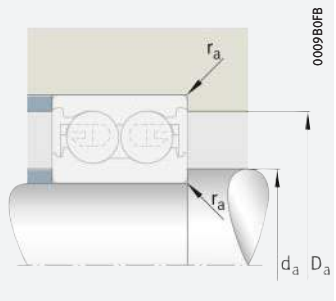
Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤322|2.12 ➤322|2.13 X-life ➤316
			N	N	N	min^{-1}	min^{-1}	≈ kg	
90	115	19	27 000	35 500	1 940	5 900	3 550	0,41	**3818-B-TVH**
	115	19	27 000	35 500	1 940	2 750	–	0,422	**3818-B-2RS-TVH**
	160	52,4	142 000	142 000	6 300	4 100	4 500	3,8	**3218-B-TVH**
	160	52,4	142 000	142 000	6 300	2 370	–	4	**3218-B-2RS-TVH**
	160	52,4	143 000	172 000	7 800	4 350	4 550	4,14	**3218**
	190	73	226 000	247 000	11 300	4 850	3 450	10,41	**3318-DA-MA**
	190	73	260 000	295 000	12 600	3 650	3 350	9,14	**3318**
95	170	55,6	161 000	193 000	8 500	5 300	4 350	5,06	**3219-M**
	200	77,8	270 000	315 000	13 100	4 450	3 200	11,21	**3319-M**
100	125	19	28 000	39 000	2 060	5 300	3 100	0,45	**3820-B-TVH**
	125	19	28 000	39 000	2 060	2 470	–	0,463	**3820-B-2RS-TVH**
	180	60,3	185 000	173 000	7 400	3 650	4 400	5,4	**3220-B-TVH**
	180	60,3	185 000	173 000	7 400	2 750	4 400	5,5	**3220-B-2Z-TVH**
	180	60,3	185 000	173 000	7 400	2 210	–	5,5	**3220-B-2RS-TVH**
	180	60,3	186 000	235 000	10 000	3 750	4 050	5,975	**3220**
	215	82,6	285 000	340 000	13 700	4 200	3 000	14,03	**3320-M**
	215	82,6	260 000	305 000	13 200	4 300	3 050	15,61	**3320-DA-MA**
105	190	65,1	215 000	270 000	11 100	4 600	3 850	7,4	**3221-M**
110	200	69,8	236 000	290 000	11 900	4 400	3 750	9,03	**3222-M**
	240	92,1	330 000	425 000	16 300	3 750	2 650	20	**3322-M**
	240	92,1	310 000	385 000	16 900	3 800	2 700	21,75	**3322-DA-MA**



32..-B, 33..-B;
with seal 2RSR, 2Z



33..-DA;
split inner ring



Mounting dimensions

Dimensions							Nominal contact angle	Mounting dimensions		
d	r	D_1	D_2	d_1	d_2	a	α	d_a	D_a	r_a
	min.	≈	≈	≈	≈	≈	°	min.	max.	max.
90	1	106,6	–	98,44	–	55	25	94,6	110,4	1
	1	–	107,2	–	96,2	55	25	94,6	110,4	1
	2	141,6	–	116,4	–	81,4	25	104	146	2
	2	–	145,2	–	112,1	81,4	25	104	146	2
	2	143,7	–	115,6	–	112,5	35	104	146	2
	3	166,2	–	131,9	–	177	45	104	176	2,5
	3	168,2	–	126,1	–	136,03	35	104	176	2,5
95	2,1	152,8	–	122,2	–	119,8	35	107	158	2,1
	3	177,3	–	133	–	143,28	35	109	186	2,5
100	1	117,9	–	109,54	–	60,2	25	104,6	120,4	1
	1	–	118,5	–	107,3	60,2	25	104,6	120,4	1
	2,1	155,7	–	124,7	–	91,3	25	112	168	2,1
	2,1	–	157,4	–	121,3	91,3	25	112	168	2,1
	2,1	–	157,4	–	121,3	91,3	25	112	168	2,1
	2,1	163,7	–	131	–	127,43	35	112	168	2,1
	3	188,7	–	142,5	–	153,28	35	114	201	2,5
	3	187,1	–	147,5	–	197,5	45	114	201	2,5
105	2,1	172,1	–	138	–	134,68	35	117	178	2,1
110	2,1	180,1	–	143,3	–	143,5	35	122	188	2,1
	3	209,6	–	161,54	–	170,54	35	124	226	2,5
	3	207,3	–	164,5	–	221	45	124	226	2,5

Four point contact bearings

Matrix for bearing preselection

The matrix gives an overview of the types and design features of four point contact bearings.

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			Four point contact bearings	
+++ extremely suitable ++ highly suitable + suitable (+) suitable with restrictions – not suitable/not applicable ✓ available			with/without retaining slots	detailed information ➤ 350
Load carrying capacity	radial		(+)	➤ 352 | 1.2
	axial, one direction		++	➤ 352 | 1.2
	axial, both directions		++	➤ 352 | 1.2
	moments		(+)	➤ 352 | 1.2
Compensation of angular misalignments	static		–	➤ 352 | 1.3
	dynamic		–	➤ 352 | 1.3
Bearing design	cylindrical bore		✓	➤ 350 | 1.1
	tapered bore		–	
	separable		✓	➤ 360 | 1.17
Lubrication	greased		–	➤ 353 | 1.4
Sealing	open		✓	➤ 353 | 1.5
	non-contact		–	➤ 353 | 1.5
	contact		–	➤ 353 | 1.5
Operating temperature in °C	from to		–30 +150[1]	➤ 354 | 1.8
Suitability for	high speeds		(+)	➤ 353 | 1.6
	high running accuracy		(+)	➤ 356 | 1.11 ➤ 114
	low-noise running		(+)	➤ 353 | 1.7
	high rigidity		+	➤ 54
	reduced friction		+	➤ 56
	length compensation within bearing		–	
	non-locating bearing arrangement		–	➤ 139
	locating bearing arrangement		++	➤ 139
X-life bearings			✓	➤ 351
Bearing bore d in mm	from to		17 200[2]	➤ 362
Product tables	from page ➤		362	

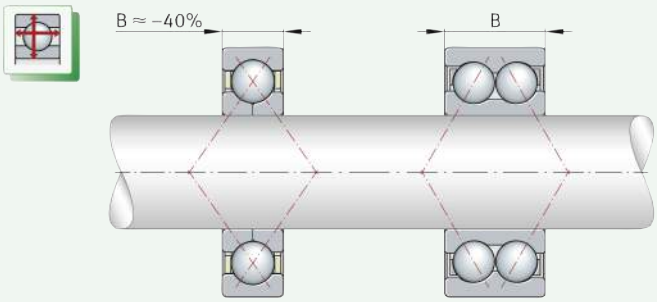
1) Valid for bearings with brass cages, D ≦ 240 mm

2) Larger catalogue bearings ➤ 🕮 *GL 1*

1 Four point contact bearings

Four point contact bearings are particularly suitable where:
- predominantly axial loads must be supported ➤*352|1.2*
- the axial design envelope is not sufficient for double row radial angular contact ball bearings
- radial forces must be supported by a separate radial bearing ➤*351|3*
- axial forces occur in both directions and a close axial guidance is required in conjunction with a small bearing width, e.g. in gearbox engineering.

For an overview of other product-specific features, see the Matrix for bearing preselection ➤*349*.



1 *Four point contact bearing and double row angular contact ball bearing – comparison of design envelope*

B = *bearing width*

1.1 Bearing design

✎ *Design variants*

Four point contact bearings are available as:
- bearings of basic design ➤*351|2*
- bearings with retaining slots in the outer ring ➤*351|3*
- X-life bearings ➤*351*.

Bearings of basic design

✎ *Comparable, in terms of product design, with single row radial angular contact ball bearings*

Four point contact bearings are single row, non-self-retaining radial ball bearings. They are similar in their structure to single row radial angular contact ball bearings; the raceways on the inner rings are, however, designed such that they can support axial loads in both directions ➤*351|2* and ➤*352|1.2*. The centre points of curvature of the arc-shaped raceways on the inner and outer ring are offset relative to each other in such a way that the balls are in contact with the bearing rings at four points under radial load ➤*351|2* and ➤*352|1.2*.

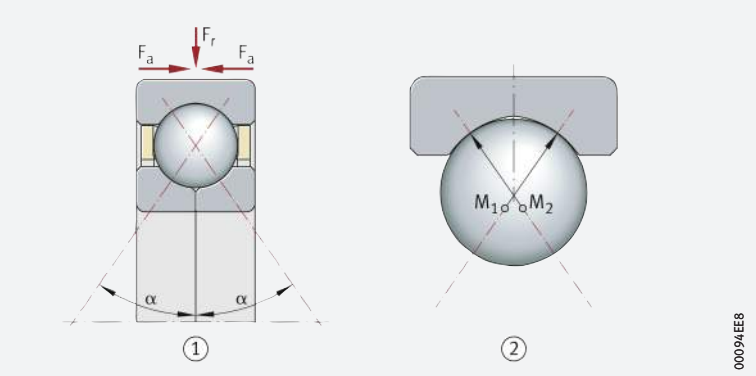
✎ *Smaller axial section height than double row angular contact ball bearings*

These bearings have solid outer rings, split inner rings and ball and cage assemblies with brass or polyamide cages ➤*355|1.9*. The two-piece inner ring allows a large complement of balls to be accommodated in the bearing. The inner ring halves are matched to the particular bearing and must not be interchanged with those of other bearings of the same size. In an axial direction, four point contact bearings are considerably narrower than, for example, double row angular contact ball bearings.

2
Four point contact bearing of basic design

α = *nominal contact angle*
M_1, M_2 = *centres of curvature of outer ring raceway*
F_r = *radial load*
F_a = *axial load*

① *Four point contact bearing, split inner ring, without retaining slots in the outer ring*
② *Raceway geometry*



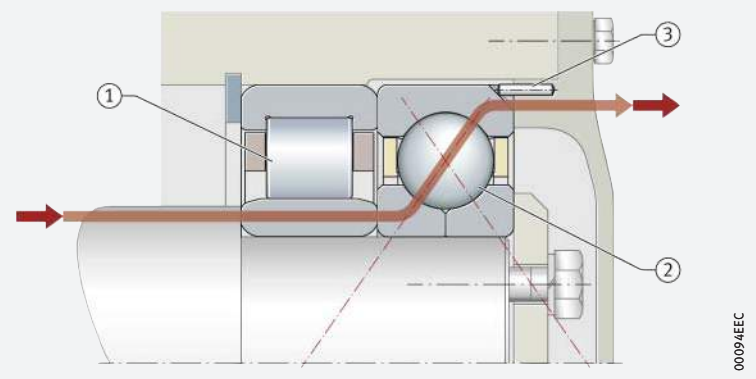
Bearings with retaining slots in the outer ring

The retaining slots allow simple location of the bearing in the housing

Four point contact bearings are often combined with a radial bearing and used as an axial bearing with radial clearance in a housing ➤*351*|*3*, ➤*358*|*1.16*. For quick and secure location of the bearings in the housing, larger bearings therefore have two retaining slots in one end face of the outer ring offset by 180° ➤*351*|*3*. Locking pins engage in these retaining slots and locate the outer ring in the housing.

3
Four point contact bearing used as an axial bearing, radial clearance on outer ring, axial force flow

① *Cylindrical roller bearing (radial bearing)*
② *Four point contact bearing with retaining slots in outer ring (axial bearing, outer ring not radially retained)*
③ *Locking pin for location of outer ring*



X-life premium quality

Four point contact bearings are available in certain sizes as X-life bearings. These bearings exhibit considerably higher performance than standard four point contact bearings ➤*352*|*4*. This is achieved, for example, through the modified internal construction, higher surface quality of the contact surfaces and optimised cage design, as well as through the improved quality of the steel and rolling elements.

Advantages

Increased customer benefits due to X-life

The technical enhancements offer a range of advantages, such as:

- a more favourable load distribution in the bearing and thus a higher dynamic load carrying capacity of the bearings ➤*286*|*6*
- quieter running
- running with reduced friction and greater energy efficiency
- lower heat generation in the bearing
- higher possible speeds
- lower lubricant consumption and, consequently, longer maintenance intervals
- a measurably longer operating life
- high operational security
- compact, environmentally-friendly bearing arrangements.

Lower operating costs, higher machine availability

In conclusion, these advantages improve the overall cost-efficiency of the bearing position significantly and thus bring about a sustainable increase in the efficiency of the machine and equipment.

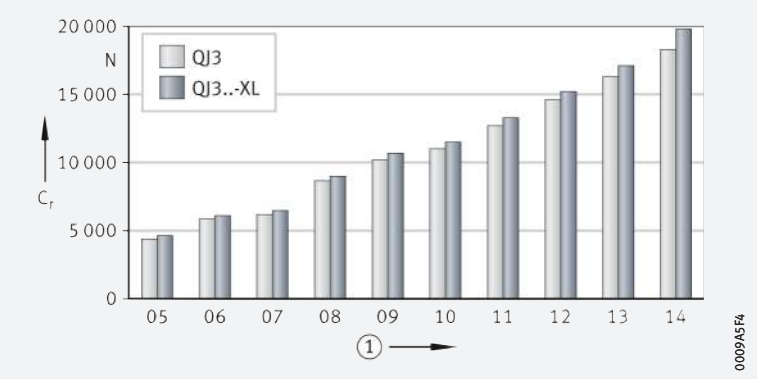
Suffix XL

X-life four point contact bearings include the suffix XL in the designation ➤*356*|▦ *4*, ➤*356*|⧉ *6* and ➤*362*|▦.

⧉ *4*
Comparison of basic dynamic load rating C_r – bearing series QJ3..-XL, bore code 5 to 14, with a bearing which is not of X-life quality

C_r = *basic dynamic load rating*

① *Bore code*



Areas of application

Wide application range

Due to their special technical features, X-life four point contact bearings are highly suitable for bearing arrangements in:

- compressors
- fluid and hydraulic pumps
- automotive chassis and gearboxes
- gearboxes for industrial, rail and wind turbine applications
- agricultural vehicles and equipment.

X-life indicates a high product performance density and thus a particularly significant benefit to the customer. Further information on X-life ➤*10*.

1.2 Load carrying capacity

Capable of supporting high axial loads in both directions

Due to the design of the raceways with their high shoulders, the large nominal contact angle of $\alpha_0 = 35°$ and the large number of rolling elements, four point contact bearings have a very high axial load carrying capacity. They are suitable for alternating, purely axial loads or predominantly axial load. The balls are in contact with the inner ring and outer ring each at one point only, as is the case with a single row angular contact ball bearing under axial load ➤*351*|⧉ *2*.

The radial load carrying capacity of the bearings is low. If predominantly radial load is present, four point contact bearings should not be used due to the higher friction in the four point contact.

1.3 Compensation of angular misalignments

Four point contact bearings cannot compensate misalignments

Four point contact bearings are not suitable for the compensation of angular misalignments due to housing deformations or shaft deflections. The possible skewing of the inner ring in relation to the outer ring depends, for example, on the bearing load, the operating clearance and the bearing size, and is very small.

Skewing of the bearing rings increases the running noise, places increased strain on the cages and has a harmful influence on the operating life of the bearings.

1.4 Lubrication

Oil or grease lubrication

The bearings are not greased. They must be lubricated with oil or grease.

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.

1.5 Sealing

The bearings are of an open design

Four point contact bearings are supplied without seals. As a result, sealing of the bearing position must be carried out in the adjacent construction. The sealing system should reliably prevent:

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

1.6 Speeds

Higher speeds are only possible under purely axial load

Due to the four point contact and resulting higher level of friction, the speed suitability of the bearings is heavily restricted under radial load. Higher speeds can only be achieved if four point contact ball bearings are subjected to purely axial load.

Limiting speeds and reference speeds in the product tables

Two speeds are generally indicated in the product tables ➤362:

- the kinematic limiting speed n_G
- the thermal speed rating $n_{\vartheta r}$.

Limiting speed

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, 75% of the value stated in the product tables is permissible in each case.

Reference speeds

$n_{\vartheta r}$ is used to calculate n_ϑ

The thermal speed rating $n_{\vartheta r}$ 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

The Schaeffler Noise Index (SGI) has been developed as a new feature for comparing the noise level of different bearing types and series. As a result, a noise evaluation of rolling bearings can now be carried out for the first time.

Schaeffler Noise Index

The SGI value is based on the maximum permissible noise level of a bearing in accordance with internal standards, which is calculated on the basis of ISO 15242. In order that different bearing types and series can be compared, the SGI value is plotted against the basic static load rating C_0.

This permits direct comparisons between bearings with the same load carrying capacity. The upper limit value is given in each of the diagrams. This means that the average noise level of the bearings is lower than illustrated in the diagram.

The Schaeffler Noise Index is an additional performance characteristic in the selection of bearings for noise-sensitive applications. The specific suitability of a bearing for an application in terms of installation space, load carrying capacity or speed limit for example, must be checked independently of this.

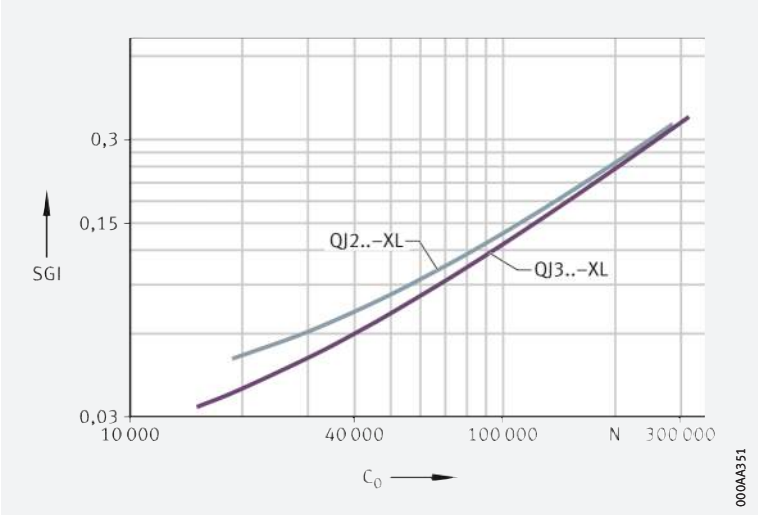
The Noise Index is currently available for the main series. Additional series will be updated and introduced in subsequent publications.

Further information:

- ***medias*** ➤ *https://medias.schaeffler.com*.

5
Schaeffler Noise Index for four point contact bearings

SGI = *Schaeffler Noise Index*
C_0 = *basic static load rating*



1.8 Temperature range

✎ *Limiting values*

The operating temperature of the bearings is limited by:

- the dimensional stability of the bearing rings and rolling elements
- the cage
- the lubricant.

Possible operating temperatures of four point contact bearings ➤ *354* | ▦ *1*.

1
Permissible temperature ranges

Operating temperature	Four point contact bearings	
	with brass cage	with polyamide cage PA66
	–30 °C to +150 °C, for D > 240 mm up to +200 °C	–30 °C to +120 °C

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

1.9 Cages

Solid cages made from brass and polyamide PA66 are used as standard

Standard cages and additional designs for four point contact bearings ➤*355*|▦*2*. Other cage designs 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 brass or sheet steel cages should be used. If there is any uncertainty regarding cage suitability, please consult Schaeffler.

▦*2*
Cage, cage suffix, bore code

Bearing series	Solid brass cage MPA		Solid cage made from polyamide PA66 TVP	
	standard	also available for	standard	also available for
	Bore code			
QJ10	12, 17, 19, 21, 22, 24, 26, 30 to 40	–	–	–
QJ2	up to 08, 10, 13, 16, 17, from 19	09, 11, 12, 14, 15, 18	09, 11,12, 14, 15, 18	08
QJ3	03, 04, from 10	05 to 09	05 to 09	–

1.10 Internal clearance

Axial internal clearance

The standard is CN

Four point contact bearings are manufactured as standard with axial internal clearance CN (normal) ➤*355*|▦*3*. CN is not stated in the designation.

Certain sizes are also available by agreement with the smaller internal clearance C2 and with the larger internal clearance C3 and C4.

The values for axial internal clearance correspond to DIN 628-4:2008 (ISO 5753-2:2010) ➤*355*|▦*3*. They are valid for bearings which are free from load and measurement forces (without elastic deformation).

▦*3*
Axial internal clearance of four point contact bearings

Nominal bore diameter d mm		Axial internal clearance							
		C2 (Group 2) µm		CN (Group N) µm		C3 (Group 3) µm		C4 (Group 4) µm	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
10	18	15	65	50	95	85	130	120	165
18	40	25	75	65	110	100	150	135	185
40	60	35	85	75	125	110	165	150	200
60	80	45	100	85	140	125	175	165	215
80	100	55	110	95	150	135	190	180	235
100	140	70	130	115	175	160	220	205	265
140	180	90	155	135	200	185	250	235	300
180	220	105	175	155	225	210	280	260	330

1.11 Dimensions, tolerances

Dimension standards

The main dimensions of four point contact bearings correspond to DIN 628-4:2008. Nominal dimensions of four point contact bearings ➤362|.

Chamfer dimensions

The limiting dimensions for chamfer dimensions correspond to DIN 620-6:2004. Overview and limiting values ➤135|7.11. Nominal value of chamfer dimension ➤362|.

Tolerances

The tolerances for the dimensional and running accuracy of four point contact bearings correspond to tolerance class Normal in accordance with ISO 492:2014. Tolerance values in accordance with ISO 492 ➤122| 8.

Retaining slots

The dimensions and tolerances of the retaining slots correspond to ISO 20515:2012 and DIN 628-4:2008.

1.12 Suffixes

For a description of the suffixes used in this chapter ➤356| 4 and ***medias*** interchange ➤ *https://www.schaeffler.de/std/1D52*.

4
Suffixes and corresponding descriptions

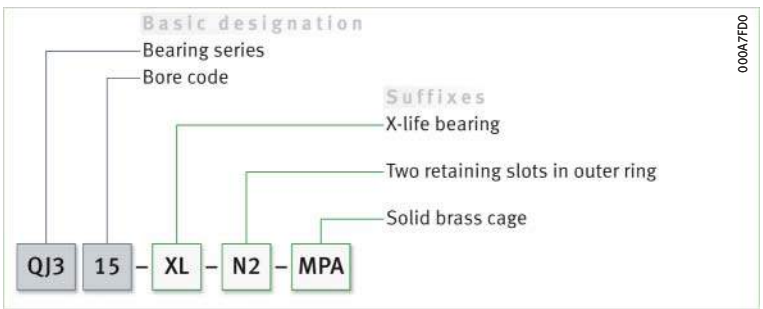
Suffix	Description of suffix	
C2	Axial internal clearance C2 (smaller than normal)	Special design, available by agreement
C3	Axial internal clearance C3 (larger than normal)	
C4	Axial internal clearance C4 (larger than C3)	
MPA	Solid brass cage, guided on outer ring	Standard, cage material dependent on bearing series and bore code
TVP	Solid cage made from glass fibre reinforced polyamide PA66	
XL	X-life bearing	Standard, dependent on bore code and bearing type
N2	Two retaining slots in outer ring	Standard for larger bearings

1.13 Structure of bearing designation

✎ *Example of composition of bearing designation*

The designation of bearings follows a set model. For an example ➤356| 6. The composition of designations is subject to DIN 623-1 ➤102| 10.

6
Four point contact bearing with two retaining slots in the outer ring: designation structure



1.14 Dimensioning

Equivalent dynamic bearing load

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

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 ($P = F_r$).

✎ *P is a substitute force for combined load and various load cases*

If this condition is not met, a constant radial force must first be determined for the rating life calculation that (in relation to the rating life) represents an equivalent load. This force is known as the equivalent dynamic bearing load P.

✎ *$F_a/F_r \leqq 0{,}95$ or $F_a/F_r > 0{,}95$*

The calculation of P is dependent on the load ratio F_a/F_r and the factor 0,95 ➤357| 1 and ➤357| 2.

1 Equivalent dynamic load

$$\frac{F_a}{F_r} \leqq 0{,}95 \quad \Rightarrow \quad P = F_r + 0{,}66 \cdot F_a$$

2 Equivalent dynamic load

$$\frac{F_a}{F_r} > 0{,}95 \quad \Rightarrow \quad P = 0{,}6 \cdot F_r + 1{,}07 \cdot F_a$$

Legend

P	N	Equivalent dynamic bearing load
F_r	N	Radial load
F_a	N	Axial load.

Equivalent static bearing load

For four point contact bearings under static load ➤357| 3.

3 Equivalent static load

$$P_0 = F_{0r} + 0{,}58 \cdot F_{0a}$$

Legend

P_0	N	Equivalent static bearing load
F_{0r}, F_{0a}	N	Largest radial or axial 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 ➤357| 4.

4 Static load safety factor

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

Legend

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 axial load of $F_a \geqq 1{,}2 \cdot F_r$ is required*

In order to ensure low friction in the bearing, especially at high speeds, a minimum axial load is required. In order to prevent an excessive increase in friction in the bearing, the axial force should be sufficiently high that the rolling elements are in contact with the inner and outer ring raceway at only one point. This is ensured if $F_a \geqq 1{,}2 \cdot F_r$.

1.16 Design of bearing arrangements

Used as axial bearing

If a four point contact bearing is used as a pure axial bearing, the outer ring must have a large radial clearance in the housing, in order that the bearing is not subjected to radial load ➤*351*|*3*.

Support bearing rings over their entire circumference and width

In order to allow full utilisation of the load carrying capacity of the bearings and thus also achieve the requisite rating life, the bearing rings must be rigidly and uniformly supported by means of contact surfaces over their entire circumference and over the entire width of the raceway (not applicable to bearings with radially relieved outer rings). The seating and contact surfaces should not be interrupted by grooves, holes or other recesses. The accuracy of mating parts must meet specific requirements ➤*359*|*5* to ➤*359*|*7*.

Radial location of bearings – fit recommendations

For secure radial location, tight fits are necessary

In addition to supporting the rings adequately, the bearings must also be securely located in a radial direction, to prevent creep of the bearing rings on the mating parts under load. This is generally achieved by means of tight fits between the bearing rings and the mating parts. If the rings are not secured adequately or correctly, this can cause severe damage to the bearings and adjacent machine parts. Influencing factors, such as the conditions of rotation, magnitude of the load, internal clearance, temperature conditions, design of the mating parts and the mounting and dismounting options must be taken into consideration in the selection of fits.

If shock type loads occur, tight fits (transition fit or interference fit) are required to prevent the rings from coming loose at any point. Clearance, transition or interference fits ➤*150*|*6* and ➤*158*|*7*.

The following information provided in Technical principles must be taken into consideration in the design of bearing arrangements:

- conditions of rotation ➤*145*
- tolerance classes for cylindrical shaft seats (radial bearings) ➤*147*|*2*
- shaft fits ➤*150*|*6*
- tolerance classes for bearing seats in housings (radial bearings) ➤*148*|*4*
- housing fits ➤*158*|*7*.

Location of the outer ring by means of retaining slots

For location of the bearings in the housing by means of retaining slots and locking pin ➤*351*|*3*.

Axial location of bearings – location methods

The bearings must also be securely located in an axial direction

As a tight fit alone is not normally sufficient to also locate the bearing rings securely on the shaft and in the housing bore in an axial direction, this must usually be achieved by means of an additional axial location or retention method. The axial location of the bearing rings must be matched to the type of bearing arrangement. Shaft and housing shoulders, housing covers, nuts, spacer rings and retaining rings etc., are fundamentally suitable ➤*351*|*3*.

Dimensional, geometrical and running accuracy of the bearing seats

A minimum of IT6 should be provided for the shaft seat and a minimum of IT7 for the housing seat

The accuracy of the bearing seat on the shaft and in the housing should correspond to the accuracy of the bearing used. For four point contact bearings with the tolerance class Normal, the shaft seat should correspond to a minimum of standard tolerance grade IT6 and the housing seat to a minimum of IT7. Guide values for the geometrical and positional tolerances of bearing seating surfaces ➤*359*|*5*, tolerances t_1 to t_3 in accordance with ➤*168*|*11*. Numerical values for IT grades ➤*359*|*6*.

5 *Guide values for the geometrical and positional tolerances of bearing seating surfaces*

Bearing tolerance class		Bearing seating surface	Standard tolerance grades to ISO 286-1 (IT grades)			
to ISO 492	to DIN 620		Diameter tolerance	Roundness tolerance t_1	Parallelism tolerance t_2	Total axial runout tolerance of abutment shoulder t_3
Normal	PN (P0)	Shaft	IT6 (IT5)	Circumferential load IT4/2	Circumferential load IT4/2	IT4
				Point load IT5/2	Point load IT5/2	
		Housing	IT7 (IT6)	Circumferential load IT5/2	Circumferential load IT5/2	IT5
				Point load IT6/2	Point load IT6/2	

6 *Numerical values for ISO standard tolerances (IT grades) to ISO 286-1:2010*

IT grade	Nominal dimension in mm							
	over	**10**	**18**	**30**	**50**	**80**	**120**	**180**	**250**
	incl.	**18**	**30**	**50**	**80**	**120**	**180**	**250**	**315**
	Values in µm								
IT4		5	6	7	8	10	12	14	16
IT5		8	9	11	13	15	18	20	23
IT6		11	13	16	19	22	25	29	32
IT7		18	21	25	30	35	40	46	52

Roughness of cylindrical bearing seating surfaces

Ra must not be too high

The roughness of the bearing seats must be matched to the tolerance class of the bearings. The mean roughness value Ra must not be too high, in order to maintain the interference loss within limits. The shafts must be ground, while the bores must be precision turned. Guide values as a function of the IT grade of bearing seating surfaces ➤*359*| 7.

7 *Roughness values for cylindrical bearing seating surfaces – guide values*

Nominal diameter of the bearing seat d (D) mm		Recommended mean roughness value for ground bearing seats Ramax µm			
		Diameter tolerance (IT grade)			
over	incl.	IT7	IT6	IT5	IT4
–	80	1,6	0,8	0,4	0,2
80	500	1,6	1,6	0,8	0,4

Mounting dimensions for the contact surfaces of bearing rings

The contact surfaces for the rings must be of sufficient height

The mounting dimensions of the shaft and housing shoulders, and spacer rings etc., must ensure that the contact surfaces for the bearing rings are of sufficient height. However, they must also reliably prevent rotating parts of the bearing from grazing stationary parts. Proven mounting dimensions for the radii and diameters of the abutment shoulders ➤*362*|. These dimensions are limiting dimensions (maximum or minimum dimensions); the actual values should not be higher or lower than specified.

1.17 Mounting and dismounting

The mounting and dismounting options for four point contact bearings, by thermal, hydraulic or mechanical methods, must be taken into consideration in the design of the bearing position.

As the bearings are not self-retaining, they are easy to mount

Four point contact bearings are not self-retaining. As a result, the outer ring with the ball and cage assembly can be mounted separately from the two inner ring halves ➤*350|1.1*. This gives simplified mounting of the bearings.

Schaeffler Mounting Handbook

Rolling bearings must be handled with great care

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.

1.18 Legal notice regarding data freshness

The further development of products may also result in technical changes to catalogue products

Of central interest to Schaeffler is the further development and optimisation of its products and the satisfaction of its customers. In order that you, as the customer, can keep yourself optimally informed about the progress that is being made here and with regard to the current technical status of the products, we publish any product changes which differ from the printed version in our electronic product catalogue.

We therefore reserve the right to make changes to the data and illustrations in this catalogue. This catalogue reflects the status at the time of printing. More recent publications released by us (as printed or digital media) will automatically precede this catalogue if they involve the same subject. Therefore, please always use our electronic product catalogue to check whether more up-to-date information or modification notices exist for your desired product.

Link to electronic product catalogue

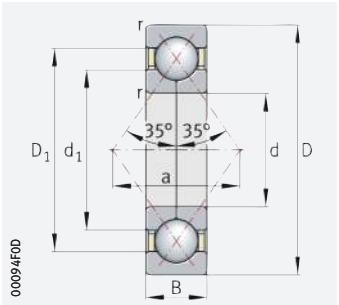
The following link will take you to the Schaeffler electronic product catalogue: ➤*https://medias.schaeffler.com*.

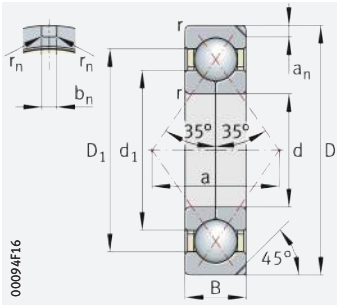
1.19 Further information

In addition to the data in this chapter, the following chapters in Technical principles must also be observed in the design of bearing arrangements:

- Determining the bearing size ➤*34*
- Rigidity ➤*54*
- Friction and increases in temperature ➤*56*
- Speeds ➤*64*
- Bearing data ➤*97*
- Lubrication ➤*70*
- Sealing ➤*182*
- Design of bearing arrangements ➤*139*
- Mounting and dismounting ➤*191*.

Four point contact bearings

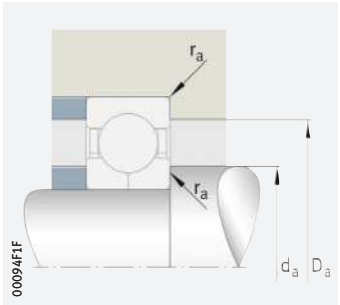




N2 variant

d = 17 – 85 mm

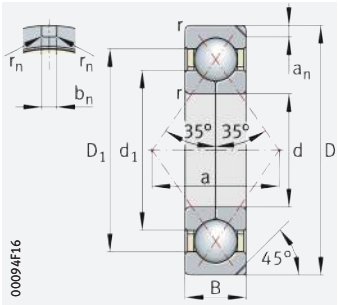
Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤*356|1.12* ➤*356|1.13* X-life ➤*351*
			N	N	N	min^{-1}	min^{-1}	≈ kg	
17	47	14	24 500	15 100	1 100	29 500	12 000	0,148	**QJ303-XL-MPA**
20	52	15	31 000	19 600	1 320	26 000	10 700	0,184	**QJ304-XL-MPA**
25	52	15	26 000	18 800	1 260	25 500	12 300	0,171	**QJ205-XL-MPA**
	62	17	46 500	31 500	2 120	14 100	8 800	0,256	**QJ305-XL-TVP**
30	62	16	37 500	27 500	1 880	21 100	10 200	0,254	**QJ206-XL-MPA**
	72	19	61 000	43 000	2 900	11 900	7 600	0,379	**QJ306-XL-TVP**
35	72	17	45 000	35 500	2 400	18 000	8 500	0,359	**QJ207-XL-MPA**
	80	21	65 000	51 000	3 400	10 800	7 000	0,516	**QJ307-XL-TVP**
40	80	18	58 000	46 500	3 150	10 600	7 500	0,399	**QJ208-XL-TVP**
	90	23	90 000	69 000	4 650	9 300	6 200	0,695	**QJ308-XL-TVP**
45	85	19	66 000	57 000	3 850	9 800	6 900	0,467	**QJ209-XL-TVP**
	100	25	107 000	83 000	6 100	8 300	5 700	0,934	**QJ309-XL-TVP**
50	90	20	62 000	56 000	3 850	13 900	6 700	0,609	**QJ210-XL-MPA**
	110	27	115 000	92 000	6 600	11 300	5 400	1,39	**QJ310-XL-MPA**
55	100	21	81 000	76 000	5 200	8 200	5 800	0,697	**QJ211-XL-TVP**
	120	29	133 000	108 000	7 900	10 300	5 000	1,76	**QJ311-XL-MPA**
60	95	18	47 500	52 000	2 600	13 100	5 800	0,42	**QJ1012-MPA**
	110	22	98 000	93 000	6 400	7 400	5 300	0,889	**QJ212-XL-TVP**
	130	31	152 000	126 000	8 900	9 500	4 700	2,2	**QJ312-XL-MPA**
65	120	23	106 000	104 000	7 000	10 300	4 900	1,27	**QJ213-XL-MPA**
	140	33	171 000	145 000	10 500	8 700	4 450	2,71	**QJ313-XL-MPA**
70	125	24	123 000	122 000	9 100	6 500	4 600	1,19	**QJ214-XL-TVP**
	150	35	198 000	165 000	11 500	8 100	4 200	3,29	**QJ314-XL-MPA**
75	130	25	129 000	130 000	9 100	6 200	4 450	1,34	**QJ215-XL-TVP**
	160	37	229 000	204 000	14 000	7 600	3 900	3,95	**QJ315-XL-N2-MPA**
80	140	26	136 000	137 000	9 400	8 600	4 250	1,84	**QJ216-XL-MPA**
	170	39	226 000	220 000	10 800	7 000	3 750	4,65	**QJ316-N2-MPA**
85	130	22	80 000	95 000	4 650	9 200	4 250	1,11	**QJ1017-N2-MPA**
	150	28	158 000	160 000	10 800	8 000	4 050	2,3	**QJ217-XL-MPA**
	180	41	248 000	255 000	12 400	6 600	3 550	5,53	**QJ317-N2-MPA**



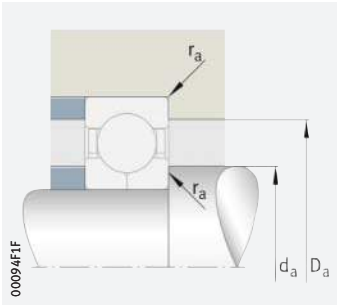
Mounting dimensions

Dimensions								Mounting dimensions		
d	r min.	D_1 ≈	d_1 ≈	a ≈	a_n	b_n	r_n	d_a min.	D_a max.	r_a max.
17	1	36,4	27,8	22	–	–	–	22,6	41,4	1
20	1,1	41,4	30,6	26	–	–	–	27	45	1
25	1	43,1	33,9	27	–	–	–	31	46	1
	1,1	49,5	37,5	31	–	–	–	32	55	1
30	1	50,7	40,4	32	–	–	–	36	56	1
	1,1	58	44	36	–	–	–	37	65	1
35	1,1	59,1	48	38	–	–	–	42	65	1
	1,5	64,8	50,8	41	–	–	–	44	71	1,5
40	1,1	66,8	53,7	42	–	–	–	47	73	1
	1,5	73,4	56,7	46	–	–	–	49	81	1,5
45	1,1	72	58,5	45	–	–	–	52	78	1
	1,5	81,7	63,4	51	–	–	–	54	91	1,5
50	1,1	76,4	63,7	49	–	–	–	57	83	1
	2	89,6	70,5	56	–	–	–	61	99	2
55	1,5	84,7	70,4	54	–	–	–	64	91	1,5
	2	97,8	77,2	61	–	–	–	66	109	2
60	1,1	83,1	72,4	54	–	–	–	66	89	1
	1,5	93	77,1	60	–	–	–	69	101	1,5
	2,1	106,9	84,2	67	–	–	–	72	118	2,1
65	1,5	101,5	84,2	65	–	–	–	74	111	1,5
	2,1	114,4	91	72	–	–	–	77	128	2,1
70	1,5	106,3	89,1	68	–	–	–	79	116	1,5
	2,1	123,6	97,7	77	–	–	–	82	138	2,1
75	1,5	111,5	93,9	72	–	–	–	84	121	1,5
	2,1	131	104,4	82	10,1	8,5	2	87	148	2,1
80	2	119,6	100,9	77	–	–	–	91	129	2
	2,1	140,8	110,7	88	10,1	8,5	2	92	158	2,1
85	1,1	114,8	101,1	75	5	6,5	0,5	91	124	1
	2	128,6	107,6	82	–	–	–	96	139	2
	3	148,7	117,9	93	11,7	10,5	2	99	166	2,5

Four point contact bearings



N2 variant



Mounting dimensions

d = 90 – 200 mm

Main dimensions			Basic load ratings		Fatigue limit load	Limiting speed	Speed rating	Mass	Designation
d	D	B	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	$n_{\vartheta r}$	m	➤*356|1.12* ➤*356|1.13* X-life ➤*351*
			N	N	N	min^{-1}	min^{-1}	≈ kg	
90	160	30	189 000	198 000	12 500	4 950	3 750	2,35	**QJ218-XL-N2-TVP**
	190	43	265 000	285 000	12 900	6 300	3 350	6,31	**QJ318-N2-MPA**
95	145	24	98 000	121 000	5 600	8 200	3 850	1,56	**QJ1019-N2-MPA**
	170	32	190 000	212 000	10 100	7 000	3 700	3,41	**QJ219-N2-MPA**
	200	45	285 000	315 000	14 100	5 900	3 250	7,45	**QJ319-N2-MPA**
100	180	34	224 000	241 000	11 200	6 600	3 550	4,02	**QJ220-N2-MPA**
	215	47	325 000	365 000	16 300	5 400	3 000	9,04	**QJ320-N2-MPA**
105	160	26	117 000	145 000	6 400	7 400	3 550	2,035	**QJ1021-N2-MPA**
	190	36	233 000	255 000	11 600	6 200	3 450	4,81	**QJ221-N2-MPA**
110	170	28	138 000	184 000	7 900	6 900	3 350	2,524	**QJ1022-N2-MPA**
	200	38	249 000	285 000	12 300	5 900	3 350	5,66	**QJ222-N2-MPA**
	240	50	345 000	415 000	17 400	4 950	2 700	12,2	**QJ322-N2-MPA**
120	180	28	145 000	200 000	8 300	6 500	3 100	2,707	**QJ1024-N2-MPA**
	215	40	285 000	340 000	14 700	5 400	3 050	6,74	**QJ224-N2-MPA**
	260	55	385 000	485 000	19 300	4 550	2 480	15,6	**QJ324-N2-MPA**
130	230	40	295 000	370 000	15 400	5 100	2 800	7,66	**QJ226-N2-MPA**
	280	58	425 000	570 000	21 600	4 200	2 220	19,2	**QJ326-N2-MPA**
140	250	42	315 000	420 000	16 500	4 700	2 600	9,69	**QJ228-N2-MPA**
	300	62	470 000	660 000	24 900	3 900	2 030	23,2	**QJ328-N2-MPA**
150	225	35	205 000	295 000	10 900	5 100	2 650	6,167	**QJ1030-N2-MPA**
	270	45	350 000	485 000	18 400	4 350	2 360	12,2	**QJ230-N2-MPA**
	320	65	510 000	730 000	25 500	3 650	1 870	28	**QJ330-N2-MPA**
160	240	38	231 000	335 000	11 900	4 750	2 600	6,35	**QJ1032-N2-MPA**
	290	48	370 000	530 000	19 900	4 050	2 200	15,3	**QJ232-N2-MPA**
170	260	42	280 000	430 000	14 800	4 350	2 340	8,788	**QJ1034-N2-MPA**
	310	52	420 000	630 000	22 800	3 750	2 010	18,6	**QJ234-N2-MPA**
180	280	46	340 000	510 000	18 700	4 050	2 140	11,42	**QJ1036-N2-MPA**
	320	52	435 000	680 000	23 900	3 600	1 870	19,6	**QJ236-N2-MPA**
190	290	46	345 000	540 000	19 200	3 900	2 010	11,4	**QJ1038-N2-MPA**
200	310	51	390 000	620 000	21 300	3 600	1 890	15	**QJ1040-N2-MPA**

Dimensions								Mounting dimensions		
d	r min.	D_1 ≈	d_1 ≈	a ≈	a_n	b_n	r_n	d_a min.	D_a max.	r_a max.
90	2	136,1	114,3	88	8,1	6,5	1	101	149	2
	3	157,1	124,5	98	11,7	10,5	2	104	176	2,5
95	1,5	128,1	112,9	84	5	6,5	0,5	102	138	1,5
	2,1	144,4	121	93	8,1	6,5	1	107	158	2,1
	3	165,4	131,2	103	11,7	10,5	2	109	186	2,5
100	2,1	153,6	127,7	98	10,1	8,5	2	112	168	2,1
	3	176,6	139	110	11,7	10,5	2	114	201	2,5
105	2	141,5	124,6	93	6,5	6,5	0,5	114	151	2
	2,1	161,6	134,8	103	10,1	8,5	2	117	178	2,1
110	2	149,8	131,3	98	6,5	6,5	0,5	119	161	2
	2,1	169,8	141,7	109	10,1	8,5	2	122	188	2,1
	3	195,5	156,5	123	11,7	10,5	2	124	226	2,5
120	2	159,2	141,3	105	6,5	6,5	0,5	129	171	2
	2,1	183,7	152,8	117	11,7	10,5	2	132	203	2,1
	3	210,6	169,9	133	11,7	10,5	2	134	246	2,5
130	3	196,2	165,4	127	11,7	10,5	2	144	216	2,5
	4	228	184,1	144	12,7	10,5	2	147	263	3
140	3	210,5	180	137	11,7	10,5	2	154	236	2,5
	4	243	197,5	154	12,7	10,5	2	157	283	3
150	2,1	199,4	176,8	131	8,1	6,5	1	160,2	214,8	2,1
	3	226,7	193,8	147	11,7	10,5	2	164	256	2,5
	4	261	211,2	165	12,7	10,5	2	167	303	3
160	2,1	212,8	188,5	140	10,1	8,5	2	170	230	2,1
	3	240	208,1	158	12,7	10,5	2	174	276	2,5
170	2,1	229,5	201,9	151	11,7	10,5	2	180,2	249,8	2,1
	4	260,5	221,5	168	12,7	10,5	2	187	293	3
180	2,1	245	215,5	161	11,7	10,5	2	190,2	269,8	2,1
	4	269	231	175	12,7	10,5	2	197	303	3
190	2,1	256,2	225,3	168	11,7	10,5	2	200,2	279,8	2,1
200	2,1	271,5	238,9	179	12,7	10,5	2	210,2	299,8	2,1

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