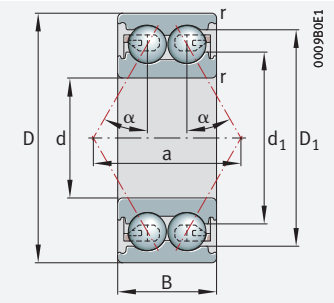
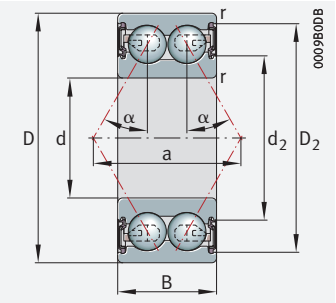
Angular contact ball bearings

Double row



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

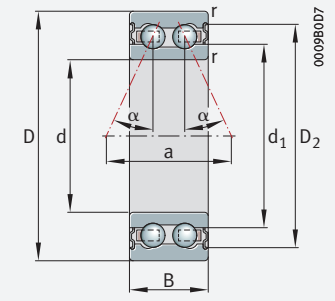


38..-B, 30..-B, 32..-BD, 33..-BD; with seal 2HRS, 2RS, 2RZ, 2Z

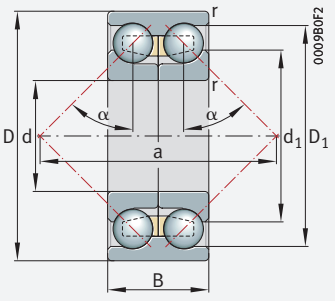
d = 90 – 110 mm

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	➤*326* | *2.12* ➤*327* | *2.13* X-life ➤*320*
			N	N	N	min^{-1}	min^{-1}	≈ kg	
90	115	19	27 000	35 500	2 000	5 900	3 550	0,41	**3818-B-TVH**
	115	19	27 000	35 500	2 000	2 750	–	0,422	**3818-B-2RS-TVH**
	160	52,4	142 000	142 000	6 500	4 100	4 500	3,8	**3218-B-TVH**
	160	52,4	142 000	142 000	6 500	2 370	–	4	**3218-B-2RS-TVH**
	160	52,4	143 000	172 000	8 000	4 350	4 550	4,14	**3218**
	190	73	226 000	247 000	11 600	4 850	3 450	10,4	**3318-DA-MA**
	190	73	260 000	295 000	13 000	3 650	3 350	9,14	**3318**
95	170	55,6	161 000	193 000	8 800	5 300	4 350	5,06	**3219-M**
	200	77,8	270 000	315 000	13 500	4 450	3 200	11,2	**3319-M**
100	125	19	28 000	39 000	2 120	5 300	3 100	0,45	**3820-B-TVH**
	125	19	28 000	39 000	2 120	2 470	–	0,463	**3820-B-2RS-TVH**
	180	60,3	185 000	173 000	7 600	3 650	4 400	5,4	**3220-B-TVH**
	180	60,3	185 000	173 000	7 600	2 750	4 400	5,5	**3220-B-2Z-TVH**
	180	60,3	185 000	173 000	7 600	2 210	–	5,5	**3220-B-2RS-TVH**
	180	60,3	186 000	235 000	10 300	3 750	4 050	5,98	**3220**
	215	82,6	285 000	340 000	14 100	4 200	3 000	14	**3320-M**
	215	82,6	260 000	305 000	13 600	4 300	3 050	15,6	**3320-DA-MA**
105	190	65,1	215 000	270 000	11 400	4 600	3 850	7,4	**3221-M**
110	200	69,8	236 000	290 000	12 200	4 400	3 750	9,03	**3222-M**
	240	92,1	330 000	425 000	16 800	3 750	2 650	20	**3322-M**
	240	92,1	310 000	385 000	17 400	3 800	2 700	21,8	**3322-DA-MA**

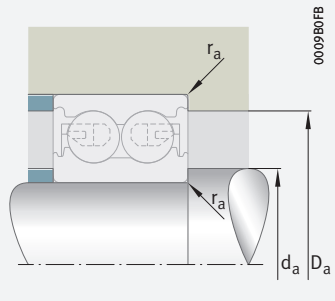
medias *https://www.schaeffler.de/std/1F9A*



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	–	98,4	–	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	35	104	176	2,5
95	2,1	152,8	–	122,2	–	119,8	35	107	158	2,1
	3	177,3	–	133	–	143,3	35	109	186	2,5
100	1	117,9	–	109,5	–	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	–	127,4	35	112	168	2,1
	3	188,7	–	142,5	–	153,3	35	114	201	2,5
	3	187,1	–	147,5	–	197,5	45	114	201	2,5
105	2,1	172,1	–	138	–	134,7	35	117	178	2,1
110	2,1	180,1	–	143,3	–	143,5	35	122	188	2,1
	3	209,6	–	161,5	–	170,5	35	124	226	2,5
	3	207,3	–	164,5	–	221	45	124	226	2,5

Four point contact bearings

Matrix for bearing preselection 353

1 Four point contact bearings 354

1.1 Bearing design 354
1.2 Load carrying capacity 356
1.3 Compensation of angular misalignments 356
1.4 Lubrication 357
1.5 Sealing 357
1.6 Speeds 357

FAG

1.7 Noise ____ *357*
1.8 Temperature range ____ *358*
1.9 Cages ____ *359*
1.10 Internal clearance ____ *359*
1.11 Dimensions, tolerances ____ *360*
1.12 Suffixes ____ *360*
1.13 Structure of bearing designation ____ *360*
1.14 Dimensioning ____ *361*
1.15 Minimum load ____ *361*
1.16 Design of bearing arrangements ____ *362*
1.17 Mounting and dismounting ____ *363*
1.18 Legal notice regarding data freshness ____ *364*
1.19 Further information ____ *364*
Product tables ____ *366*
Four point contact bearings ____ *366*

Matrix for bearing preselection

The matrix gives an overview of the types and design features.

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.

+++ extremely suitable
++ highly suitable
+ suitable
(+) suitable with restrictions
– not suitable/not applicable
✓ available

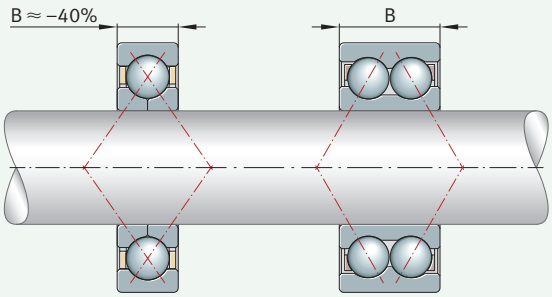
Design features and suitability			Four point contact bearings	
			with/without retaining slots	detailed information ➤ 354
Load carrying capacity	radial		(+)	➤ 356 | 1.2
	axial, one direction		++	➤ 356 | 1.2
	axial, both directions		++	➤ 356 | 1.2
	moments		(+)	➤ 356 | 1.2
Compensation of angular misalignments	static		–	➤ 356 | 1.3
	dynamic		–	➤ 356 | 1.3
Bearing design	cylindrical bore		✓	➤ 354 | 1.1
	tapered bore		–	
	separable		✓	➤ 363 | 1.17
Lubrication	greased		–	➤ 357 | 1.4
Sealing	open		✓	➤ 357 | 1.5
	non-contact		–	➤ 357 | 1.5
	contact		–	➤ 357 | 1.5
Operating temperature in °C	from to		–30 +150[1]	➤ 358 | 1.8
Suitability for	high speeds		(+)	➤ 357 | 1.6
	high running accuracy		(+)	➤ 360 | 1.11 ➤ 115
	low-noise running		(+)	➤ 357 | 1.7
	high rigidity		+	➤ 54
	reduced friction		+	➤ 56
	length compensation within bearing		–	
	non-locating bearing arrangement		–	➤ 141
	locating bearing arrangement		++	➤ 141
X-life bearings		X-life	✓	➤ 355
Bearing bore d in mm	from to		17 200[2]	➤ 366
Product tables	from page ➤		366	

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 ➤*356|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 ➤*355|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 ➤*353*.



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 ➤*355|2*
- bearings with retaining slots in the outer ring ➤*355|3*
- X-life bearings ➤*355*

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 ➤*355|2* and ➤*356|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 ➤*355|2* and ➤*356|1.2*.

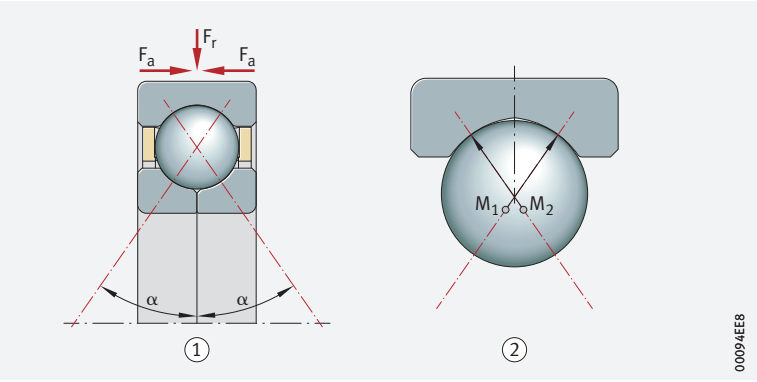
✎ *Smaller axial section height than double row angular contact ball bearings*

These bearings have solid outer rings, split inner rings and ball and cage assemblies with brass or polyamide cages ➤*359|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*



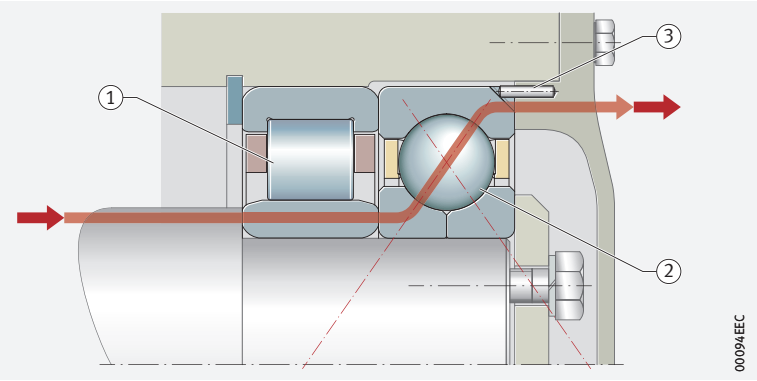
Bearings with retaining slots in the outer ring

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 ➤*355*|*3*, ➤*362*|*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° ➤*355*|*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

X-life

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 ➤*356*|*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 ➤*290*|*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.

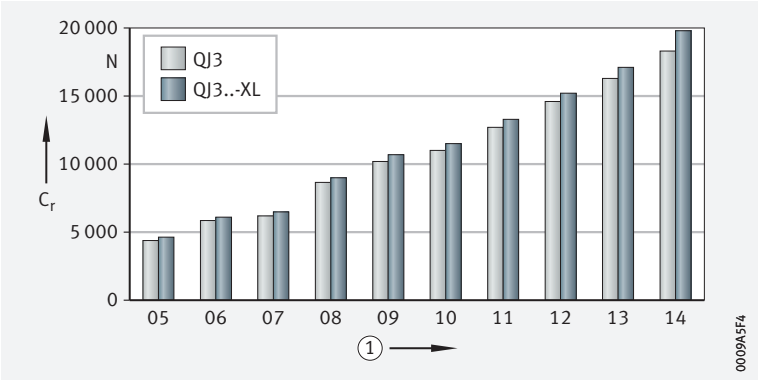
Suffix XL

X-life four point contact bearings include the suffix XL in the designation ➤*360*| 4, ➤*360*| 6 and ➤*366*|.

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 ➤*355*| 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.

Speeds in the product tables

The product tables generally give two speeds for the bearings:

- 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 in the product tables are valid for oil lubrication.

Bearings with solid brass cages have a significantly higher limiting speed for oil lubrication.

Values for grease lubrication

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

For the grease lubrication of bearings with solid brass cages, 58% 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.

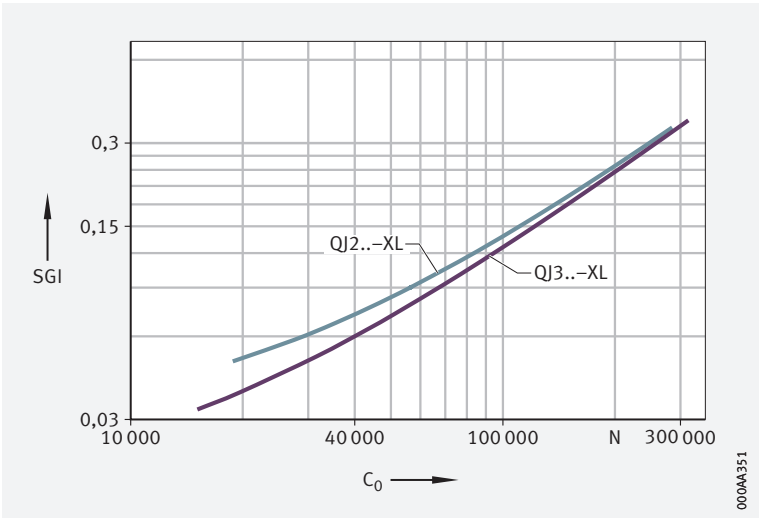
The Noise Index is currently available for the main series. Additional series will be updated and introduced in subsequent publications.

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 ➤*358*| ▦ *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 ➤*359*|▦*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) ➤*359*|▦*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) ➤*359*|▦*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 ➤366|.

Chamfer dimensions

The limiting dimensions for chamfer dimensions correspond to DIN 620-6:2004. Overview and limiting values ➤137|7.11. Nominal value of chamfer dimension ➤366|.

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 ➤124|8.

Retaining slots

The dimensions and tolerances of the retaining slots are based on ISO 20515:2021 bzw. DIN 628-4:2008.

1.12 Suffixes

Suffixes describe the design and features of a bearing in more detail.

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

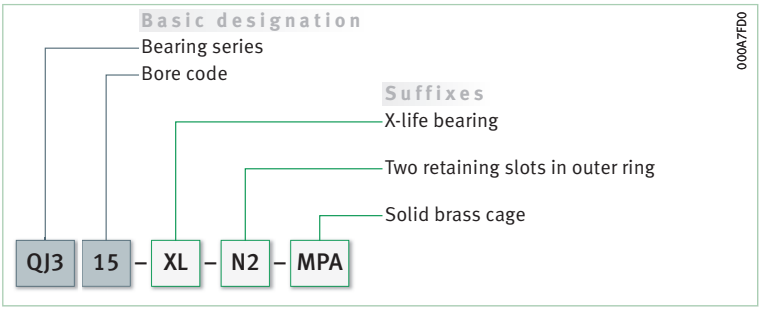
1.13 Structure of bearing designation

With ***medias*** interchange, equivalent Schaeffler bearing designations can be determined for bearing designations from other rolling bearing manufacturers *https://www.schaeffler.de/std/1B69*.

✎ *Example of composition of bearing designation*

The designation of bearings follows a set model. For an example ➤360|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 ➤*361*|*1* and ➤*361*|*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 ➤*361*|*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 ➤*361*|*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 ➤355|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 ➤363|5 to ➤363|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 ➤152|6 and ➤160|7.

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

- criteria for selection of fits ➤146
- conditions of rotation ➤147
- tolerance classes for cylindrical shaft seats (radial bearings) ➤149|2
- shaft fits ➤152|6
- tolerance classes for bearing seats in housings (radial bearings) ➤150|4
- housing fits ➤160|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 ➤355|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 ➤355|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 ➤363|5. Tolerances t_1 to t_3 in accordance with ➤170|11. Numerical values for IT grades ➤363|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 ➤*363*| 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 ➤*366*|. 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 ➤*354|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.

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Link to electronic product catalogue

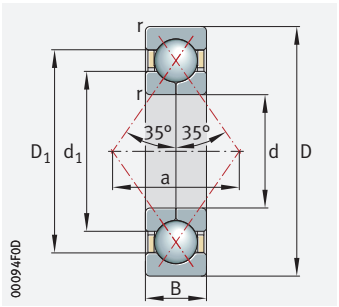
The following link will take you to the Schaeffler electronic product catalogue: *https://medias.schaeffler.com*.

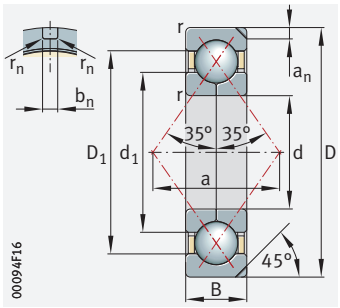
1.19 Further information

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 ➤*185*
- Design of bearing arrangements ➤*141*
- Mounting and dismounting ➤*194*

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	➤360|1.12 ➤360|1.13 X-life ➤355
			N	N	N	min^{-1}	min^{-1}	≈ kg	
17	47	14	24 500	15 100	1 130	29 500	12 000	0,148	**QJ303-XL-MPA**
20	52	15	31 000	19 600	1 360	26 000	10 700	0,184	**QJ304-XL-MPA**
25	52	15	26 000	18 800	1 300	25 500	12 300	0,171	**QJ205-XL-MPA**
	62	17	46 500	31 500	2 180	14 100	8 800	0,256	**QJ305-XL-TVP**
30	62	16	37 500	27 500	1 930	21 100	10 200	0,254	**QJ206-XL-MPA**
	72	19	61 000	43 000	3 000	11 900	7 600	0,379	**QJ306-XL-TVP**
35	72	17	45 000	35 500	2 470	18 000	8 500	0,359	**QJ207-XL-MPA**
	80	21	65 000	51 000	3 500	10 800	7 000	0,516	**QJ307-XL-TVP**
40	80	18	58 000	46 500	3 250	10 600	7 500	0,399	**QJ208-XL-TVP**
	90	23	90 000	69 000	4 750	9 300	6 200	0,695	**QJ308-XL-TVP**
45	85	19	66 000	57 000	4 000	9 800	6 900	0,467	**QJ209-XL-TVP**
	100	25	107 000	83 000	6 200	8 300	5 700	0,934	**QJ309-XL-TVP**
50	90	20	62 000	56 000	3 950	13 900	6 700	0,609	**QJ210-XL-MPA**
	110	27	115 000	92 000	6 800	11 300	5 400	1,39	**QJ310-XL-MPA**
55	100	21	81 000	76 000	5 300	8 200	5 800	0,697	**QJ211-XL-TVP**
	120	29	133 000	108 000	8 100	10 300	5 000	1,76	**QJ311-XL-MPA**
60	95	18	51 000	52 000	3 600	13 100	5 800	0,42	**QJ1012-XL-MPA**
	110	22	98 000	93 000	6 600	7 400	5 300	0,889	**QJ212-XL-TVP**
	130	31	152 000	126 000	9 200	9 500	4 700	2,2	**QJ312-XL-MPA**
65	120	23	106 000	104 000	7 200	10 300	4 900	1,27	**QJ213-XL-MPA**
	140	33	171 000	145 000	10 800	8 700	4 450	2,71	**QJ313-XL-MPA**
70	125	24	123 000	122 000	9 300	6 500	4 600	1,19	**QJ214-XL-TVP**
	150	35	198 000	165 000	11 800	8 100	4 200	3,29	**QJ314-XL-MPA**
75	130	25	129 000	130 000	9 300	6 200	4 450	1,34	**QJ215-XL-TVP**
	160	37	229 000	204 000	14 400	7 600	3 900	3,95	**QJ315-XL-N2-MPA**
80	140	26	136 000	137 000	9 700	8 600	4 250	1,84	**QJ216-XL-MPA**
	170	39	226 000	220 000	11 100	7 000	3 750	4,65	**QJ316-N2-MPA**
85	130	22	86 000	95 000	6 400	9 200	4 250	1,11	**QJ1017-XL-N2-MPA**
	150	28	158 000	160 000	11 100	8 000	4 050	2,3	**QJ217-XL-MPA**
	180	41	248 000	255 000	12 800	6 600	3 550	5,53	**QJ317-N2-MPA**

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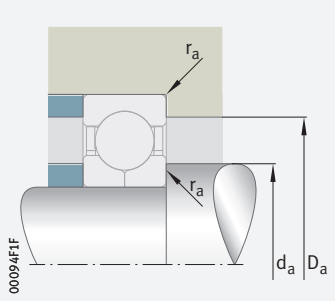
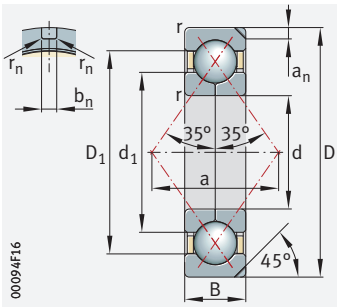


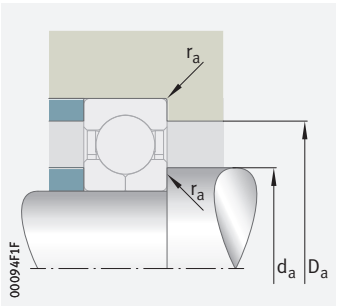
Mounting dimensions

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	➤360|1.12 ➤360|1.13 X-life ➤355
			N	N	N	min^{-1}	min^{-1}	≈ kg	
90	160	30	189 000	198 000	12 900	4 950	3 750	2,35	**QJ218-XL-N2-TVP**
	190	43	265 000	285 000	13 300	6 300	3 350	6,31	**QJ318-N2-MPA**
95	145	24	106 000	121 000	7 600	8 200	3 850	1,56	**QJ1019-XL-N2-MPA**
	170	32	190 000	212 000	10 400	7 000	3 700	3,41	**QJ219-N2-MPA**
	200	45	285 000	315 000	14 500	5 900	3 250	7,45	**QJ319-N2-MPA**
100	180	34	224 000	241 000	11 500	6 600	3 550	4,02	**QJ220-N2-MPA**
	215	47	325 000	365 000	16 800	5 400	3 000	9,04	**QJ320-N2-MPA**
105	160	26	126 000	145 000	8 700	7 400	3 550	2,04	**QJ1021-XL-N2-MPA**
	190	36	233 000	255 000	12 000	6 200	3 450	4,81	**QJ221-N2-MPA**
110	170	28	138 000	184 000	8 100	6 900	3 350	2,52	**QJ1022-N2-MPA**
	200	38	249 000	285 000	12 700	5 900	3 350	5,66	**QJ222-N2-MPA**
	240	50	345 000	415 000	18 000	4 950	2 700	12,2	**QJ322-N2-MPA**
120	180	28	145 000	200 000	8 500	6 500	3 100	2,71	**QJ1024-N2-MPA**
	215	40	285 000	340 000	15 100	5 400	3 050	6,74	**QJ224-N2-MPA**
	260	55	385 000	485 000	19 900	4 550	2 480	15,6	**QJ324-N2-MPA**
130	230	40	295 000	370 000	15 800	5 100	2 800	7,66	**QJ226-N2-MPA**
	280	58	425 000	570 000	22 200	4 200	2 220	19,2	**QJ326-N2-MPA**
140	250	42	315 000	420 000	16 900	4 700	2 600	9,69	**QJ228-N2-MPA**
	300	62	470 000	660 000	25 500	3 900	2 030	23,2	**QJ328-N2-MPA**
150	225	35	205 000	295 000	11 200	5 100	2 650	6,17	**QJ1030-N2-MPA**
	270	45	350 000	485 000	18 900	4 350	2 360	12,2	**QJ230-N2-MPA**
	320	65	510 000	730 000	26 000	3 650	1 870	28	**QJ330-N2-MPA**
160	240	38	231 000	335 000	12 300	4 750	2 600	6,35	**QJ1032-N2-MPA**
	290	48	370 000	530 000	20 500	4 050	2 200	15,3	**QJ232-N2-MPA**
170	260	42	280 000	430 000	15 200	4 350	2 340	8,79	**QJ1034-N2-MPA**
	310	52	420 000	630 000	23 500	3 750	2 010	18,6	**QJ234-N2-MPA**
180	280	46	340 000	510 000	19 200	4 050	2 140	11,4	**QJ1036-N2-MPA**
	320	52	435 000	680 000	24 600	3 600	1 870	19,6	**QJ236-N2-MPA**
190	290	46	345 000	540 000	19 800	3 900	2 010	11,4	**QJ1038-N2-MPA**
200	310	51	390 000	620 000	22 000	3 600	1 890	15	**QJ1040-N2-MPA**

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