SCHAEFFLER



# Super Precision Bearings

Spindle bearings, super precision cylindrical roller bearings, axial angular contact ball bearings

Catalogue

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# Preface

Spindle bearing arrangements play a decisive role in the performance of machine tools and have a considerable influence on both the achievable cutting parameters and the quality and stability of the machining process. In addition, virtually no other component in machine tools is operated at its load limit and, on occasion, even overloaded than the spindle bearing arrangement.

Selecting a spindle bearing arrangement that is optimally suited to technical and economic criteria and designed to a high degree of accuracy is, without doubt, a key task in machine tool construction. Indeed, it is not uncommon for the spindle bearing arrangement to be referred to as a supreme discipline.

In order to guide you quickly and easily to your optimum spindle bearing arrangement, whilst also incorporating all parameters as precisely as possible, Schaeffler offers you the following options:

- Technically sound advice from our engineers in Application Engineering, who guide several hundred development projects through to volume production every year.
- Spindle design using our calculation and simulation tool Bearinx-online Spindle Calculation. Registered customers use the same calculation basis as our engineers in Application Engineering, giving them access to decades of experience in spindle bearing arrangement design and allowing factors such as shaft deflection, rolling contact elasticity and bearing ring expansion to be taken into account. Bearinx-online also ensures a simple, rapid and secure exchange of data and calculations between you and Schaeffler.
- Catalogue SP 1 is also available to you in parallel as an entry point and important source of information.

Catalogue SP 1 describes all rolling bearing arrangements available from Schaeffler for use in machine tool spindles. In addition, this catalogue serves as a technical compendium for the selection, design, operation, mounting and monitoring of spindle bearing arrangements, providing a summary of the key technical information for designers in a single publication. A final note on the nomenclature: Our spindle bearing range is essentially composed of the following rolling bearing arrangements:

- spindle bearings (angular contact bearings)
- super precision cylindrical roller bearings
- axial angular contact ball bearings

# 1 Technical principles

## 1.1 Components and materials

### 1.1.1 Steels for bearing rings and rolling elements

#### 1.1.1.1 Standard rolling bearing steel 100Cr6

The bearing rings and rolling elements of FAG standard spindle bearings are made in principle from through hardening rolling bearing steel 100Cr6. Rings made from these materials are dimensionally stabilised as standard to at least +120 °C. Other dimensional stabilisations are available by agreement.

#### 1.1.1.2 High performance steel Vacrodur

For high performance applications, especially in motor spindles with very high speeds, Schaeffler offers the bearings with rings made from the high performance steel Vacrodur and ceramic rolling elements. The material used for the rings is a high performance steel with an exceptionally homogeneous and fine structure.

Vacrodur has, in comparison with the normal rolling bearing steel 100Cr6, a significantly higher hardness above 65 HRC combined with simultaneously high toughness. As a result, the permissible contact pressure is higher.

Tests on the material fatigue life have given life values higher by a factor of 13 compared to 100Cr6. The basic dynamic load rating is up to 140 % higher compared to 100Cr6. Due to its high hardness, Vacrodur gives significantly more robust behaviour in collision in comparison with 100Cr6. The static load carrying capacity is increased by 40 %.

In the event of lubricant contamination, the high hardness and toughness of the material leads to a reduction in initial damage caused by overrolling of foreign particles. In the mixed friction range, rating life values of up to 25 times the normal value have even been achieved.

It is also significantly superior to conventional rolling bearing steels where high temperature hardness is concerned.

The longer life of Vacrodur bearings compared to conventional bearings makes a considerable contribution to reducing system costs.

### 1.1.2 Materials for rolling elements

Standard bearings have rolling elements made from 100Cr6.

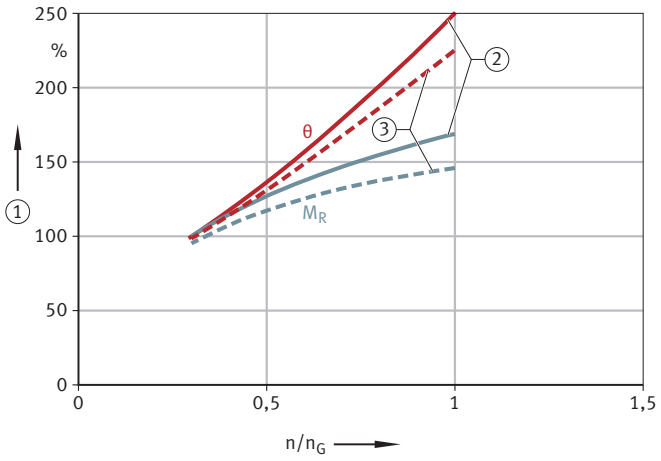
Hybrid bearings with rings made from standard rolling bearing steel (HCB, HCM, HC) and Vacrodur (VCM) are fitted with ceramic balls made from silicon nitride ($Si_3N_4$). In comparison with steel rolling elements, ceramic rolling elements offer many advantages:

- excellent tribological behaviour in the combination of steel and ceramic:
  - significantly reduced strain on the material
  - significantly reduced strain on the lubricant
- lower density:
  - reduced centrifugal forces on the rolling elements
  - improved bearing kinematics as the mass is lower than steel by 60 %
- lower coefficient of thermal expansion of the ceramic rolling elements with positive effect on the change in bearing preload in response to temperature differences in operation
- no magnetism and high current insulation

1 Comparison of silicon nitride $Si_3N_4$ and rolling bearing steel 100Cr6

| **Material parameters at room temperature** | | **Silicon nitride $Si_3N_4$** | **Rolling bearing steel 100Cr6** |
|---|---|---|---|
| Density | $g/cm^3$ | 3,2 ... 3,25 | 7,8 ... 7,85 |
| Coefficient of thermal expansion | $10^{-6}\ K^{-1}$ | 3,2 | 11,5 |
| Modulus of elasticity | $kN/mm^2$ | 315 ... 320 | 200 ... 210 |
| Hardness | HV 10 | 1600 | 700 |
| Flexural strength | $N/mm^2$ | 600, 700 | 2500 |
| Fracture toughness | $MPa \cdot \sqrt{m}$ | 7 | 20 |
| Thermal conductivity | $W/(m \cdot K)$ | 30 ... 35 | 40 ... 45 |
| Specific electrical resistance | $\Omega \cdot mm^2/m$ | $10^{17}$ ... $10^{18}$ | 0,1 ... 1 |

1 Frictional torque and temperature profile, comparison of steel bearings and hybrid bearings




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| | | | |
|---|---|---|---|
| $n/n_G$ | Speed relative to limiting speed | $M_R$ | Frictional torque of bearing |
| θ | Temperature of outer ring | 1 | Relative change in frictional torque with temperature |
| 2 | Steel bearing | 3 | Hybrid bearing |

While these bearings were originally envisaged only for the high speed range, they are now used at significantly lower speeds too. The reasons for this include their robust design and reliability as well as the significantly longer grease operating life.

### 1.1.3 Cage function and materials for cages

The cage is an important functional part in a rolling bearing and has the following characteristics:

- The cage keeps the rolling elements separate from each other.
- The cage maintains the spacing between the rolling elements, thus giving more uniform load distribution.
- The cage guides the rolling elements in the unloaded zone of the bearing.
- The cage prevents the rolling elements from falling out in bearings that can be separated or swivelled out, thus allowing easier mounting of the bearing.

FAG super precision bearings are fitted with various solid cages made from laminated fabric, brass or plastic.

#### 1.1.3.1 Angular contact ball bearings with laminated fabric cages

FAG angular contact ball bearings of P4S accuracy class are fitted with phenolic resin/cotton laminated fabric cages. The laminated fabric cages are guided on the outer ring and have good emergency running characteristics (suffix T). The laminated fabric is a high performance material with excellent tribological characteristics. In cases of lubricant starvation in particular, the material is characterised by excellent emergency running characteristics and, in this respect, is thus superior to many thermoplastics. The maximum operating temperature of laminated fabric cages is +100 °C.

#### 1.1.3.2 Cylindrical roller bearings and double direction axial angular contact ball bearings

Super precision cylindrical roller bearings of series NNU49, N10 and NN30 with a bore diameter outside the range of 30 mm to 120 mm have solid brass cages as standard (suffix M1 with crosspiece rivets for single row bearings, M for double row bearings). Furthermore, double direction axial angular contact ball bearings of the series 2344 are fitted with ball-guided solid brass cages (suffix M). The maximum operating temperature of brass cages is +150 °C.

##### Solid brass cage and polyamide

The new FAG X-life cylindrical roller bearings of series N10 and NN30 and in the bore diameter range 30 to 120 mm are fitted with a window cage made from polyamide. In tests, double row bearings in particular show a significantly improved speed suitability and a temperature lower by up to 12 K in comparison with bearings with brass cages. As a result of the lower increase in temperature, speeds up to 25 % can be achieved in the limiting speed test.

A further advantage of the lower running temperature is the longer grease operating life. The basic dynamic load rating is higher by up to 19 %. The light plastic cage (suffix TVP) with better damping characteristics reduces bearing noise so that the bearings run more quietly. The maximum operating temperature of TVP cages is +120 °C.

High Speed cylindrical roller bearings in X-life design, specifically for motor spindles, are available with a cage made from PEEK (PEEK = polyether ether ketone) (suffix PVPA1). Since displacement on the non-locating bearing side of motor spindles only ever occurs in one direction in operation, the cage can be guided unilaterally. Unilateral guidance leads to a more rapid grease distribution cycle with lower maximum temperatures and subsequently to a lower temperature level with smaller scatter. As a result, the non-locating bearing function is more reliable even in the highest speed ranges.

The maximum operating temperature of PEEK cages is +150 °C.

2 Cages



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### 1.1.4 Seal materials

Main spindle bearings that are greased and sealed on both sides have non-contact sealing by means of sealing washers made from nitrile butadiene rubber (NBR). Seals made from NBR can be used up to a temperature of +100 °C. For temperatures at a continuously high level, seals made from FKM materials are recommended. Bearings for pneumatic oil lubrication of the design DLR are each fitted with 2 O-rings made from FKM.

In accordance with the REACH Regulation (EC) 1907/2006, all seals in FAG main spindle bearings manufactured since 1.1.2015 are free from DEHP (bis(2-ethylhexyl) phthalate, CAS no. 117-81-7).

### 1.1.5 Coatings

Coatings are recommended in certain applications. In order to prevent current passage, to improve anti-corrosion or anti-wear protection or even to increase tribological characteristics under unfavourable lubrication conditions, coating is a proven method that can significantly optimise the performance capability of the bearings or increase their life.

In particular, thin dense chromium coating is used frequently in the case of main spindle bearings in order to prevent fretting corrosion of the outer ring. This coating option is available under the suffix J24J. Other coating options are available by agreement.

## 1.2 Tolerances

### 1.2.1 Definitions and measurement principles

The definition of the tolerances and the associated measurement principles are described in this chapter.

The symbols for the nominal dimensions of radial bearings indicate the size dimensions and spacings and, with the exception of the font, are listed in accordance with ISO 15241 ➤11|▦2.

The symbols for the nominal dimensions of axial bearings indicate the size dimensions and spacings and are listed in accordance with DIN EN ISO 1101 and ISO 14405-1 ➤14|▦3.

2 Symbols for nominal dimensions of radial rolling bearings ISO 492:2014

| Symbols for nominal dimensions | GPS symbol and specification modifier | Description for radial bearings | Old term |
|---|---|---|---|
| **Tolerance symbol for characteristic** | **Symbols in accordance with DIN EN ISO 1101 and ISO 14405-1** | **ISO 492:2014 (based on DIN EN ISO 1101, ISO 5459 and ISO 14405-1)** | **In accordance with ISO 1132-1:2000** |
| **Width** | | | |
| B | – | Nominal inner ring width | Nominal inner ring width |
| $t_{\Delta Bs}$ | (LP) | Symmetrical rings<br>Deviation of a two-point size of inner ring width from its nominal size<br>ΔBs = Bs – B<br>Bs = single two-point size of inner ring width | Deviation of a single inner ring width |
| $t_{\Delta Bs}$ | (GN)ALS⟨⌯⌷<br>(LP) | Asymmetrical rings, upper limit<br>Deviation of a minimum circumscribed size of inner ring width, between 2 opposite lines, in any longitudinal section which includes the inner ring bore axis, from its nominal size | Deviation of a single inner ring width |
| $t_{\Delta Bs}$ | (GN)ALS⟨⌯⌷<br>(LP) | Asymmetrical rings, lower limit<br>Deviation of a two-point size of inner ring width from its nominal size | Deviation of a single inner ring width |
| $t_{VBs}$ | (LP)(SR) | Symmetrical rings<br>Range of two-point sizes of inner ring width<br>VBs = Bs max – Bs min | Variation of inner ring width |
| $t_{VBs}$ | (GN)ALS(SR)⟨⌯⌷ | Asymmetrical rings<br>Range of minimum circumscribed sizes of inner ring width, between 2 opposite lines, obtained from any longitudinal section which includes the inner ring bore axis | Variation of inner ring width |
| C | – | Nominal outer ring width | Nominal outer ring width |
| $t_{\Delta Cs}$ | (LP) | Symmetrical rings<br>Deviation of a two-point size of outer ring width from its nominal size<br>ΔCs = Cs – C<br>Cs = single two-point size of outer ring width | Deviation of a single outer ring width |
| $t_{\Delta Cs}$ | (GN)ALS⟨⌯⌷<br>(LP) | Asymmetrical rings, upper limit<br>Deviation of a minimum circumscribed size of outer ring width, between 2 opposite lines, in any longitudinal section which includes the outer ring outside surface axis, from its nominal size | Deviation of a single outer ring width |
| $t_{\Delta Cs}$ | (GN)ALS⟨⌯⌷<br>(LP) | Asymmetrical rings, lower limit<br>Deviation of a two-point size of outer ring width from its nominal size | Deviation of a single outer ring width |
| $t_{VCs}$ | (LP)(SR) | Symmetrical rings<br>Range of two-point sizes of outer ring width<br>VCs = Cs max – Cs min | Variation of outer ring width |
| $t_{VCs}$ | (GN)ALS(SR)⟨⌯⌷ | Asymmetrical rings<br>Range of minimum circumscribed sizes of outer ring width, between 2 opposite lines, obtained from any longitudinal section which includes the outer ring outside surface axis | Variation of outer ring width |
| **Diameter** | | | |
| d | – | Nominal bore diameter of a cylindrical bore or at the theoretical small end of a tapered bore | Nominal bore diameter |
| $t_{\Delta ds}$ | (LP) | Deviation of a two-point size of the bore diameter from its nominal size<br>Δds = ds – d | Deviation of a single bore diameter |
| $t_{Vdsp}$ | (LP)(SR)ACS | Range of two-point sizes of bore diameter in any cross-section of a cylindrical or tapered bore<br>Vdsp = ds max – ds min | Variation of single bore diameter in a single plane |

| Symbols for nominal dimensions | GPS symbol and specification modifier | Description for radial bearings | Old term |
|---|---|---|---|
| **Tolerance symbol for characteristic** | **Symbols in accordance with DIN EN ISO 1101 and ISO 14405-1** | **ISO 492:2014 (based on DIN EN ISO 1101, ISO 5459 and ISO 14405-1)** | **In accordance with ISO 1132-1:2000** |
| $t_{\Delta dmp}$ | (LP)(SD)ACS | Cylindrical bore<br>Deviation of a mid-range size (out of two-point sizes) of bore diameter in any cross-section from its nominal size<br>dmp = (d max + d min)/2<br>Δdmp = dmp – d | Deviation of mean bore diameter in a single plane |
| $t_{\Delta dmp}$ | (LP)(SD)SCS | Tapered bore<br>Deviation of a mid-range size (out of two-point sizes) of bore diameter at the theoretical small end of a tapered bore from its nominal size | Deviation of mean bore diameter in a single plane |
| $t_{Vdmp}$ | (LP)(SD)ACS(SR) | Range of mid-range sizes (out of two-point sizes) of bore diameter obtained from any cross-section of a cylindrical bore<br>Vdmp = dmp max – dmp min | Variation of mean bore diameter |
| $d_1$ | – | Nominal diameter at the theoretical large end of a tapered bore | Variation of mean bore diameter |
| $t_{\Delta d1mp}$ | (LP)(SD)SCS | Deviation of a mid-range size (out of two-point sizes) of bore diameter at the theoretical large end of a tapered bore from its nominal size | Variation of mean bore diameter |
| D | – | Nominal size of outside diameter | Nominal outside surface diameter |
| $t_{\Delta Ds}$ | (LP) | Deviation of a two-point size of outside diameter from its nominal size | Deviation of a single outside diameter |
| $t_{VDsp}$ | (LP)(SR)ACS | Range of two-point sizes of outside diameter in any cross-section | Variation of a single outside diameter in a single plane |
| $t_{\Delta Dmp}$ | (LP)(SD)ACS | Deviation of a mid-range size (out of two-point sizes) of outside diameter in any cross-section from its nominal size<br>Dmp = (D max + D min)/2<br>ΔDmp = Dmp – D | Deviation of mean outside diameter in a single plane |
| $t_{VDmp}$ | (LP)(SD)ACS(SR) | Range of mid-range sizes (out of two-point sizes) of outside diameter obtained from any cross-section<br>VDmp = Dmp max – Dmp min | Variation of mean outside surface diameter |
| **Running accuracy** | | | |
| $t_{Kea}$ | ↗ | Circular radial run-out of outer ring outside surface of assembled bearing with respect to datum, i.e. axis, established from the inner ring bore surface | Radial run-out of outer ring of assembled bearing |
| $t_{Kia}$ | ↗ | Circular radial run-out of inner ring bore of assembled bearing with respect to datum, i.e. axis, established from the outer ring outside surface | Radial run-out of inner ring of assembled bearing |
| $t_{Sd}$ | ↗ | Circular axial run-out of inner ring face with respect to datum, i.e. axis, established from the inner ring bore surface | Perpendicularity of inner ring face with respect to the bore |
| $t_{SD}$ | ⊥ | Perpendicularity of outer ring outside surface axis with respect to datum established from the outer ring face | Perpendicularity of outer ring outside surface with respect to the face |
| $t_{Sea}$ | ↗ | Circular axial run-out of outer ring face of assembled bearing with respect to datum, i.e. axis, established from the inner ring bore surface | Axial run-out of outer ring of assembled bearing |
| $t_{Sia}$ | ↗ | Circular axial run-out of inner ring face of assembled bearing with respect to datum, i.e. axis, established from the outer ring outside surface | Axial run-out of inner ring of assembled bearing |
| **Tapered bore** | | | |
| SL | – | Taper slope: The difference between nominal diameters at the theoretical large end and small end of a tapered bore<br>SL = d1 – d<br>SL = spacing | – |

| Symbols for nominal dimensions | GPS symbol and specification modifier | Description for radial bearings | Old term |
|---|---|---|---|
| **Tolerance symbol for characteristic** | **Symbols in accordance with DIN EN ISO 1101 and ISO 14405-1** | **ISO 492:2014 (based on DIN EN ISO 1101, ISO 5459 and ISO 14405-1)** | **In accordance with ISO 1132-1:2000** |
| $t_{\Delta SL}$ | – | Deviation of taper slope of a tapered bore from its nominal size (description based on DIN EN ISO 1119)<br>$\Delta SL = \Delta d1mp - \Delta dmp$ | – |
| α | – | Frustum angle of tapered inner ring bore | – |
| **Width of assembled bearing** | | | |
| T | – | Nominal assembled bearing width | Nominal bearing width |
| $t_{\Delta Ts}$ | (GN) | Deviation of minimum circumscribed size of assembled bearing width from its nominal size | Deviation of the actual bearing width |
| $T_1$ | – | Nominal effective width of inner subunit assembled with a master outer ring | Nominal effective width of inner subunit |
| $t_{\Delta T1s}$ | (GN) | Deviation of minimum circumscribed size of effective width (inner subunit assembled with a master outer ring) from its nominal size | Deviation of the actual effective width of inner subunit |

3 Symbols for nominal dimensions of axial rolling bearings ISO 199:2014

| Symbols for nominal dimensions | GPS symbol and specification modifier | Description for axial bearings | Old term |
|---|---|---|---|
| **Tolerance symbol for characteristic** | **Symbols in accordance with DIN EN ISO 1101 and ISO 14405-1** | **ISO 199:2014 (based on DIN EN ISO 1101, ISO 5459 and ISO 14405-1)** | **In accordance with ISO 1132-1:2000** |
| **Diameter** | | | |
| d | – | Nominal bore diameter of shaft washer, single-direction bearing | Nominal bore diameter of shaft washer |
| $t_{\Delta dmp}$ | (LP)(SD)ACS | Nominal bore diameter of shaft washer, single-direction bearing | Deviation of mean bore diameter in a single plane |
| $t_{Vdsp}$ | (LP)(SR)ACS | Deviation of a mid-range size (out of two-point sizes) of shaft washer bore diameter in any cross-section from its nominal size<br>dmp = (d max + d min)/2<br>Δdmp = dmp – d | Variation of single bore diameter in a single plane |
| D | – | Nominal outside diameter of housing washer | Nominal outside diameter of bore (housing washer) |
| $t_{\Delta Dmp}$ | (LP)(SD)ACS | Deviation of a mid-range size (out of two-point sizes) of housing washer outside diameter in any cross-section from its nominal size<br>Dmp = (D max + D min)/2<br>ΔDmp = Dmp – D | Deviation of mean outside diameter in a single plane |
| $t_{VDsp}$ | (LP)(SR)ACS | Range of two-point sizes of housing washer outside diameter in any cross-section<br>VDsp = Ds max – Ds min | Variation of a single outside diameter in a single plane |
| **Height** | | | |
| T | – | Nominal assembled bearing height, single-direction bearing | Nominal bearing height |
| $t_{\Delta Ts}$ | (GN) | Deviation of minimum circumscribed size of assembled bearing height from its nominal size, single-direction bearing | Deviation of the actual bearing height |
| $T_1$ | – | Nominal assembled bearing height, double-direction bearing | – |
| $t_{\Delta T1s}$ | (GN) | Deviation of minimum circumscribed size of assembled bearing height from its nominal size, double-direction bearing | – |
| $t_{Se}$ | (LP)(SR) | Axial cylindrical roller bearings<br>Range of two-point sizes of thickness between housing washer raceway and the back face | Variation in thickness between housing washer raceway and back face |
| $t_{Se}$ | (LS)(SN)ALS(SR)⌖ | Axial ball bearings<br>Range of minimum spherical sizes between the raceway and the opposite back face of the housing washer, obtained from any longitudinal section which includes the housing washer outside surface axis | Variation in thickness between housing washer raceway and back face |
| $t_{Si}$ | (LP)(SR) | Axial cylindrical roller bearings<br>Range of two-point sizes of thickness between shaft washer raceway and the back face | Variation in thickness between shaft washer raceway and back face |
| $t_{Si}$ | (LS)(SN)ALS(SR)⌖ | Axial ball bearings<br>Range of minimum spherical sizes between the raceway and the opposite back face of the shaft washer, obtained from any longitudinal section which includes the shaft washer bore axis | Variation in thickness between shaft washer raceway and back face |

### 1.2.2 Tolerances of super precision bearings

Rolling bearing tolerances are standardised in accordance with ISO 492:2014 for radial rolling bearings and in accordance with ISO 199:2014 for axial rolling bearings. Definitions for the meanings of dimensions and tolerances are regulated in ISO 1132.

In order to ensure full use of the bearing performance capacity and a high machining accuracy, the dimensional, geometrical and running accuracy of super precision bearings is produced within very narrow tolerance ranges.

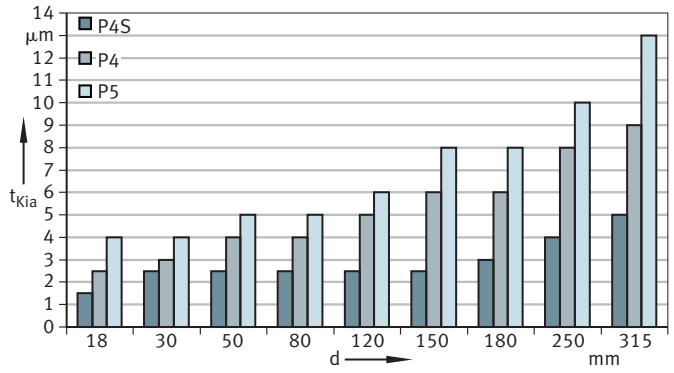
In general, super precision spindle bearings (including BAX) are manufactured to the accuracy standard P4S.

All cylindrical roller bearings and axial angular contact ball bearings (2344) are manufactured in standard cases in accordance with the Schaeffler internal accuracy requirement SP. In this case, the roundness and running tolerances correspond to at least ISO tolerance class 4.

P4S means:

- mean deviations in accordance with ISO tolerance class 4
- all geometrical and running tolerances in accordance with ISO tolerance class 2

3 Radial runout tolerances of the inner ring for P4S, P4, P5




| | | | |
|---|---|---|---|
| $t_{Kia}$ | Radial runout | d | Bore diameter |

#### 1.2.2.1 Restricted diameter tolerance to P4S-K5

Spindle bearings are also available by agreement with a restricted diameter tolerance. The tolerance range is at the centre of the diameter tolerance. The tolerance width is 1/3 of the diameter tolerance.

#### 1.2.2.2 Actual value codes and actual deviation

The actual value codes for the bore and the outside diameter as well as the actual deviation of the bearing width from the nominal dimension are stated on the end faces of the inner and outer rings and on the packaging label.

### 1.2.2.3 Tolerances of the inner and outer ring in spindle bearings

The following values are valid as tolerances for the inner and outer ring in spindle bearings.

4 Tolerances of the inner ring (tolerance class P4S)

| Nominal size | | Variation (out of roundness) | | Variation of mean diameter | Deviation | | Variation of width | Width deviation | | Radial runout | Axial runout | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | | $t_{Vdsp}$ | | $t_{Vdmp}$ | $t_{\Delta dmp}$ [1], $t_{\Delta ds}$ | | $t_{VBs}$ | $t_{\Delta Bs}$ | | $t_{Kia}$ | $t_{Sd}$ | $t_{Sia}$ |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | Series 9 | Series 0,2 | | | | | | | | | |
| – | 10 | 2,5 | 2 | 1,5 | 0 | –4 | 1,5 | 0 | –100 | 1,5 | 1,5 | 1,5 |
| 10 | 18 | 2,5 | 2 | 1,5 | 0 | –4 | 1,5 | 0 | –100 | 1,5 | 1,5 | 1,5 |
| 18 | 30 | 2,5 | 2 | 1,5 | 0 | –5 | 1,5 | 0 | –120 | 2,5 | 1,5 | 2,5 |
| 30 | 50 | 3 | 2,5 | 2 | 0 | –6 | 1,5 | 0 | –120 | 2,5 | 1,5 | 2,5 |
| 50 | 80 | 3,5 | 3 | 2 | 0 | –7 | 1,5 | 0 | –150 | 2,5 | 1,5 | 2,5 |
| 80 | 120 | 4 | 3 | 2,5 | 0 | –8 | 2,5 | 0 | –200 | 2,5 | 2,5 | 2,5 |
| 120 | 150 | 5 | 4 | 3 | 0 | –10 | 2,5 | 0 | –250 | 2,5 | 2,5 | 2,5 |
| 150 | 180 | 5 | 4 | 3 | 0 | –10 | 4 | 0 | –250 | 3 | 4 | 5 |
| 180 | 250 | 6 | 5 | 4 | 0 | –12 | 5 | 0 | –300 | 4 | 5 | 5 |
| 250 | 315 | 8 | 6 | 5 | 0 | –15 | 6 | 0 | –350 | 5 | 6 | 7 |
| 315 | 400 | 10 | 8 | 6 | 0 | –19 | 7 | 0 | –400 | 7 | 7 | 9 |
| 400 | 500 | 12 | 10 | 8 | 0 | –23 | 8 | 0 | –450 | 8 | 8 | 11 |
| 500 | 630 | 13 | 10 | 8 | 0 | –26 | 10 | 0 | –500 | 9 | 10 | 13 |
| 630 | 800 | 16 | 13 | 10 | 0 | –32 | 12 | 0 | –750 | 10 | 12 | 15 |

1) For series 719.

5 Tolerances of the outer ring (tolerance class P4S)

| Nominal size | | Deviation | | Variation (out of roundness) | | Variation of mean diameter | Variation of width | Radial runout | Axial runout | |
|---|---|---|---|---|---|---|---|---|---|---|
| D | | $t_{\Delta Ds}$, $t_{\Delta Dmp}$ [2] | | $t_{VDsp}$ [3] | | $t_{VDmp}$ | $t_{VCs}$ | $t_{Kea}$ | $t_{SD}$ | $t_{Se}$ |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | Series 9 | Series 0,2 | | | | | |
| 10 | 18 | 0 | –4 | 2,5 | 2 | 1,5 | 1,5 | 1,5 | 0,75 | 1,5 |
| 18 | 30 | 0 | –5 | 2,5 | 2 | 1,5 | 1,5 | 2,5 | 0,75 | 2,5 |
| 30 | 50 | 0 | –6 | 3 | 2,5 | 2 | 1,5 | 2,5 | 0,75 | 2,5 |
| 50 | 80 | 0 | –7 | 3,5 | 3 | 2 | 1,5 | 3 | 0,75 | 4 |
| 80 | 120 | 0 | –8 | 4 | 3 | 2,5 | 2,5 | 4 | 1,25 | 5 |
| 120 | 150 | 0 | –9 | 5 | 4 | 3 | 2,5 | 4 | 1,25 | 5 |
| 150 | 180 | 0 | –10 | 5 | 4 | 3 | 2,5 | 5 | 1,25 | 5 |
| 180 | 250 | 0 | –11 | 6 | 5 | 4 | 4 | 7 | 2 | 7 |
| 250 | 315 | 0 | –13 | 7 | 6 | 4 | 5 | 7 | 2,5 | 7 |
| 315 | 400 | 0 | –15 | 8 | 6 | 5 | 7 | 8 | 3,5 | 8 |
| 400 | 500 | 0 | –18 | 9 | 7 | 6 | 7 | 9 | 4 | 10 |
| 500 | 630 | 0 | –22 | 11 | 9 | 7 | 8 | 11 | 4,5 | 12 |
| 630 | 800 | 0 | –26 | 13 | 10 | 8 | 9 | 13 | 5 | 14 |
| 800 | 1000 | 0 | –33 | 17 | 14 | 11 | 11 | 15 | 6 | 17 |

2) For series 719.

3) Valid for open bearings. For sealed bearings and DLR bearings, the values apply before assembly.

### 6 Tolerances of the bearing bore (tolerance class P4S-K5)

| Nominal size | | Deviation | |
|---|---|---|---|
| d | | $t_{\Delta ds}$, $t_{\Delta dmp}$ [4] | |
| mm | mm | µm | µm |
| over | incl. | | |
| – | 10 | –1,5 | –3 |
| 10 | 18 | –1,5 | –3 |
| 18 | 30 | –1,5 | –3,5 |
| 30 | 50 | –2 | –4 |
| 50 | 80 | –2,5 | –5 |
| 80 | 120 | –2,5 | –5,5 |
| 120 | 150 | –3 | –7 |
| 150 | 180 | –3 | –7 |
| 180 | 250 | –4 | –8 |
| 250 | 315 | –5 | –10 |
| 315 | 400 | –6 | –13 |
| 400 | 500 | –7 | –16 |
| 500 | 630 | –8 | –18 |
| 630 | 800 | –11 | –21 |

[4] For series 719.

### 7 Tolerances of the outside diameter (tolerance class P4S-K5)

| Nominal size | | Deviation | |
|---|---|---|---|
| D | | $t_{\Delta DS}$, $t_{\Delta Dmp}$ | |
| mm | mm | µm | µm |
| over | incl. | | |
| 10 | 18 | –1,5 | –3 |
| 18 | 30 | –1,5 | –3,5 |
| 30 | 50 | –2 | –4 |
| 50 | 80 | –2,5 | –5 |
| 80 | 120 | –2,5 | –5,5 |
| 120 | 150 | –3 | –6 |
| 150 | 180 | –3 | –7 |
| 180 | 250 | –3,5 | –7,5 |
| 250 | 315 | –4 | –9 |
| 315 | 400 | –5 | –10 |
| 400 | 500 | –6 | –12 |
| 500 | 630 | –7 | –15 |
| 630 | 800 | –8 | –18 |
| 800 | 1000 | –11 | –22 |

### 1.2.2.4 Dimensional, geometrical and positional tolerances of super precision cylindrical roller bearings

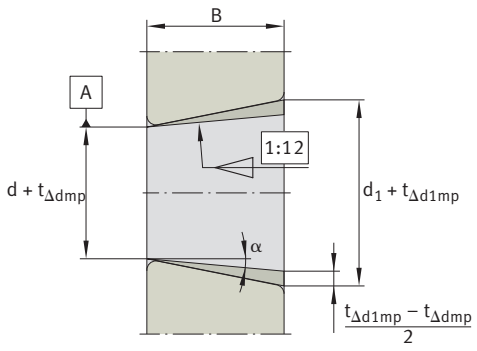
For the deviation of the tapered bore $t_{\Delta dmp}$, the following illustration ➤18|⧉4 and table values apply.

For series N10 and HCN10, the values in the tables apply ➤18|▦8 ➤18|▦9.

For series NN30 and NNU49, the values in the tables apply ➤19|▦10 ➤19|▦11.

The width deviation $t_{\Delta Cs}$ is identical to $t_{\Delta Bs}$ of the corresponding inner ring.

⧉4 Tolerances for tapered bores




| | | | |
|---|---|---|---|
| α | Inclination angle at end of taper 2° 23' 9,4" | 2α | Taper angle at end of taper 4° 46' 18,8" |
| B | Width of inner ring | d | Nominal bearing bore diameter |
| $d_1$ | Bore diameter at large end of taper | $t_{\Delta dmp}$ | Deviation of bore diameter from nominal dimension in a single radial plane |

▦8 Tolerances of the inner ring for single row bearings (tolerance class SP)

| Nominal size | | Deviation of cyl. bore | | Deviation of tap. bore | | Variation (out of roundness) | | Variation of mean diameter | Deviation | | Variation of width | Width deviation | | Radial runout | Axial runout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | | $t_{\Delta d}$, $t_{\Delta dmp}$ | | $t_{\Delta dmp}$ | | $t_{Vdsp}$ | | $t_{Vdmp}$ | $t_{\Delta d1mp}$, $t_{\Delta dmp}$ | | $t_{VBs}$ | $t_{\Delta Bs}$ | | $t_{Kia}$ | $t_{Sd}$ |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | cyl. | tap. | | | | | | | | |
| 18 | 30 | 0 | −6 | 10 | 0 | 3 | 3 | 3 | 4 | 0 | 1,5 | 0 | −120 | 3 | 3 |
| 30 | 50 | 0 | −8 | 12 | 0 | 4 | 4 | 4 | 4 | 0 | 2 | 0 | −120 | 4 | 3 |
| 50 | 80 | 0 | −9 | 15 | 0 | 5 | 5 | 5 | 5 | 0 | 3 | 0 | −150 | 4 | 4 |
| 80 | 120 | 0 | −10 | 20 | 0 | 5 | 5 | 5 | 6 | 0 | 3 | 0 | −200 | 5 | 4 |
| 120 | 180 | 0 | −13 | 25 | 0 | 7 | 7 | 7 | 8 | 0 | 4 | 0 | −250 | 6 | 5 |
| 180 | 250 | 0 | −15 | 30 | 0 | 8 | 8 | 8 | 9 | 0 | 5 | 0 | −300 | 8 | 6 |
| 250 | 315 | 0 | −18 | 35 | 0 | 9 | 9 | 9 | 11 | 0 | 6 | 0 | −350 | 9 | 7 |
| 315 | 400 | 0 | −23 | 40 | 0 | 12 | 12 | 12 | 12 | 0 | 7 | 0 | −400 | 10 | 9 |
| 400 | 500 | 0 | −27 | 45 | 0 | 14 | 14 | 14 | 14 | 0 | 8 | 0 | −450 | 12 | 11 |
| 500 | 630 | 0 | −30 | 50 | 0 | 15 | 15 | 15 | 15 | 0 | 10 | 0 | −500 | 14 | 13 |
| 630 | 800 | 0 | −40 | 65 | 0 | 20 | 20 | 20 | 18 | 0 | 12 | 0 | −750 | 17 | 15 |

9 Tolerances of the outer ring for single row bearings (tolerance class SP)

| Nominal size | | Deviation | | Variation (out of roundness) | Variation of mean diameter | Variation of width | Radial runout | Perpendicularity |
|---|---|---|---|---|---|---|---|---|
| D | | $t_{\Delta Ds}$, $t_{\Delta Dmp}$ | | $t_{VDsp}$ | $t_{VDmp}$ | $t_{VCs}$ | $t_{Kea}$ | $t_{SD}$ |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | | |
| 30 | 50 | 0 | –7 | 4 | 4 | 2,5 | 5 | 2 |
| 50 | 80 | 0 | –9 | 5 | 5 | 3 | 5 | 2 |
| 80 | 120 | 0 | –10 | 5 | 5 | 4 | 6 | 2,5 |
| 120 | 150 | 0 | –11 | 6 | 6 | 5 | 7 | 2,5 |
| 150 | 180 | 0 | –13 | 7 | 7 | 5 | 8 | 2,5 |
| 180 | 250 | 0 | –15 | 8 | 8 | 7 | 10 | 3,5 |
| 250 | 315 | 0 | –18 | 9 | 9 | 7 | 11 | 4 |
| 315 | 400 | 0 | –20 | 10 | 10 | 8 | 13 | 5 |
| 400 | 500 | 0 | –23 | 12 | 12 | 9 | 15 | 5,5 |
| 500 | 630 | 0 | –28 | 14 | 14 | 11 | 17 | 6,5 |
| 630 | 800 | 0 | –35 | 18 | 18 | 13 | 20 | 7,5 |
| 800 | 1000 | 0 | –40 | 20 | 20 | 15 | 23 | 8,5 |

10 Tolerances of the inner ring SP for double row bearings (tolerance class SP)

| Nominal size | | Deviation of cyl. bore | | Deviation of tap. bore | | Variation (out of roundness) | | Variation of mean diameter | Deviation | | Variation of width | Width deviation | | Radial runout | Axial runout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d | | $t_{\Delta d}$, $t_{\Delta dmp}$ | | $t_{\Delta dmp}$ | | $t_{Vdsp}$ | | $t_{Vdmp}$ | $t_{\Delta d1mp}$, $t_{\Delta dmp}$ | | $t_{VBs}$ | $t_{\Delta Bs}$ | | $t_{Kia}$ | $t_{Sd}$ |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | cyl. | tap. | | | | | | | | |
| 18 | 30 | 0 | –6 | 10 | 0 | 3 | 3 | 3 | 4 | 0 | 2,5 | 0 | –120 | 3 | 4 |
| 30 | 50 | 0 | –8 | 12 | 0 | 4 | 4 | 4 | 5 | 0 | 3 | 0 | –120 | 4 | 4 |
| 50 | 80 | 0 | –9 | 15 | 0 | 5 | 5 | 5 | 5 | 0 | 4 | 0 | –150 | 4 | 5 |
| 80 | 120 | 0 | –10 | 20 | 0 | 5 | 5 | 5 | 7 | 0 | 4 | 0 | –200 | 5 | 5 |
| 120 | 180 | 0 | –13 | 25 | 0 | 7 | 7 | 7 | 8 | 0 | 5 | 0 | –250 | 6 | 6 |
| 180 | 250 | 0 | –15 | 30 | 0 | 8 | 8 | 8 | 9 | 0 | 6 | 0 | –300 | 8 | 7 |
| 250 | 315 | 0 | –18 | 35 | 0 | 9 | 9 | 9 | 11 | 0 | 8 | 0 | –350 | 8 | 8 |
| 315 | 400 | 0 | –23 | 40 | 0 | 12 | 12 | 12 | 12 | 0 | 10 | 0 | –400 | 10 | 10 |
| 400 | 500 | 0 | –27 | 45 | 0 | 14 | 14 | 14 | 14 | 0 | 12 | 0 | –450 | 10 | 12 |
| 500 | 630 | 0 | –30 | 50 | 0 | 15 | 15 | 15 | 15 | 0 | 14 | 0 | –500 | 12 | 14 |
| 630 | 800 | 0 | –40 | 65 | 0 | 20 | 20 | 20 | 20 | 0 | 17 | 0 | –750 | 15 | 17 |

11 Tolerances of the outer ring SP for double row bearings (tolerance class SP)

| Nominal size | | Deviation | | Variation (out of roundness) | Variation of mean diameter | Variation of width | Radial runout | Perpendicularity |
|---|---|---|---|---|---|---|---|---|
| D | | $t_{\Delta Ds}$, $t_{\Delta Dmp}$ | | $t_{VDsp}$ | $t_{VDmp}$ | $t_{VCs}$ | $t_{Kea}$ | $t_{SD}$ |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | | |
| 30 | 50 | 0 | –7 | 4 | 4 | 2,5 | 5 | 4 |
| 50 | 80 | 0 | –9 | 5 | 5 | 3 | 5 | 4 |
| 80 | 120 | 0 | –10 | 5 | 5 | 4 | 6 | 5 |
| 120 | 150 | 0 | –11 | 6 | 6 | 5 | 7 | 5 |
| 150 | 180 | 0 | –13 | 7 | 7 | 5 | 8 | 5 |
| 180 | 250 | 0 | –15 | 8 | 8 | 7 | 10 | 7 |
| 250 | 315 | 0 | –18 | 9 | 9 | 7 | 11 | 8 |
| 315 | 400 | 0 | –20 | 10 | 10 | 8 | 13 | 10 |
| 400 | 500 | 0 | –23 | 12 | 12 | 9 | 15 | 11 |
| 500 | 630 | 0 | –28 | 14 | 14 | 11 | 17 | 13 |
| 630 | 800 | 0 | –35 | 18 | 18 | 13 | 20 | 15 |
| 800 | 1000 | 0 | –40 | 20 | 20 | 15 | 23 | 17 |

### 1.2.2.5 Dimensional, geometrical and positional tolerances of axial angular contact ball bearings

The dimensional, geometrical and running tolerances correspond to tolerance class SP.

12 Tolerances of the shaft locating washer

| Nominal size | | Deviation | | Variation (out of roundness) | Wall thickness variation | Height deviation | |
|---|---|---|---|---|---|---|---|
| d | | $t_{\Delta dmp}$ | | $t_{Vdsp}$ | $t_{Si}$ | $t_{\Delta Hs}$ | |
| mm | mm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | |
| 18 | 30 | 0 | –8 | 6 | 3 | 50 | –150 |
| 30 | 50 | 0 | –10 | 8 | 3 | 75 | –200 |
| 50 | 80 | 0 | –12 | 9 | 4 | 100 | –250 |
| 80 | 120 | 0 | –15 | 11 | 4 | 125 | –300 |
| 120 | 150 | 0 | –18 | 14 | 5 | 150 | –350 |
| 150 | 180 | 0 | –18 | 14 | 5 | 150 | –350 |
| 180 | 250 | 0 | –22 | 17 | 5 | 175 | –400 |
| 250 | 315 | 0 | –25 | 19 | 7 | 200 | –450 |
| 315 | 400 | 0 | –30 | 22 | 7 | 250 | –600 |
| 400 | 500 | 0 | –35 | 26 | 9 | 300 | –750 |

13 Tolerances of the housing locating washer

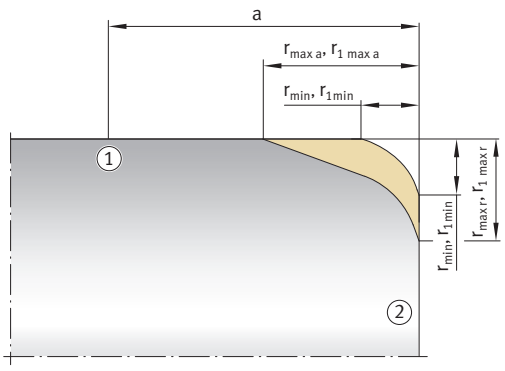
| Nominal size | | Variation (out of roundness) | Wall thickness variation | Deviation of outside diameter | | Width deviation |
|---|---|---|---|---|---|---|
| D | | $t_{VDsp}$ | $t_{Se}$ | $t_{\Delta Dmp}$ | | $t_{\Delta Cs}$ |
| mm | mm | µm | µm | µm | µm | µm |
| over | incl. | | | | | |
| 30 | 50 | 5 | 3 | –20 | –36 | –120 |
| 50 | 80 | 6 | 4 | –24 | –43 | –120 |
| 80 | 120 | 8 | 4 | –28 | –50 | –125 |
| 120 | 150 | 9 | 5 | –33 | –58 | –125 |
| 150 | 180 | 9 | 5 | –33 | –58 | –125 |
| 180 | 250 | 10 | 5 | –37 | –66 | –125 |
| 250 | 315 | 12 | 7 | –41 | –73 | –150 |
| 315 | 400 | 13 | 7 | –46 | –82 | –150 |
| 400 | 500 | 15 | 9 | –50 | –90 | –200 |
| 500 | 630 | 16 | 11 | –55 | –99 | –200 |
| 630 | 800 | 18 | 13 | –60 | –110 | –250 |

### 1.2.2.6 Chamfer dimensions

The tables describe the chamfer dimensions for:

- radial bearings with a cylindrical bore
- radial bearings with a tapered bore
- axial bearings

5 Limit chamfer dimensions




| | | | |
|---|---|---|---|
| a | Measurement spacing: this spacing is used for inspection of the bore or outside diameter tolerances | $r_{min}$<br>$r_{1\,min}$ | Symbol for smallest chamfer dimension in radial and axial direction |
| $r_{max\,r}$<br>$r_{1\,max\,r}$ | Largest chamfer dimension in radial direction | $r_{max\,a}$<br>$r_{1\,max\,a}$ | Largest chamfer dimension in axial direction |
| 1 | Bore or outside diameter | 2 | Lateral face |

14 Chamfer dimension of radial bearings with cylindrical bore

| **Bore** | | **Chamfer dimension** | | | **Measurement spacing** |
|---|---|---|---|---|---|
| | | **–** | **radial** | **axial** | |
| **d** | | **$r_{min}$**<br>**$r_{1\,min}$** | **$r_{max\,r}$** | **$r_{max\,a}$**<br>**$r_{1\,max\,a}$** | **a** |
| **mm** | **mm** | **mm** | **mm** | **mm** | **mm** |
| **over** | **incl.** | | | | |
| – | – | 0,1 | 0,2 | 0,4 | 0,9 |
| – | – | 0,15 | 0,3 | 0,6 | 1,1 |
| – | – | 0,2 | 0,5 | 0,8 | 1,3 |
| – | 40 | 0,3 | 0,6 | 1 | 1,5 |
| 40 | – | 0,3 | 0,8 | 1 | 1,5 |
| – | 40 | 0,6 | 1 | 2 | 2,5 |
| 40 | – | 0,6 | 1,3 | 2 | 2,5 |
| – | 50 | 1 | 1,5 | 3 | 3,6 |
| 50 | – | 1 | 1,9 | 3 | 3,6 |
| – | 120 | 1,1 | 2 | 3,5 | 4,2 |
| 120 | – | 1,1 | 2,5 | 4 | 4,8 |
| – | 120 | 1,5 | 2,3 | 4 | 4,8 |
| 120 | – | 1,5 | 3 | 5 | 6 |
| – | 80 | 2 | 3 | 4,5 | 5,4 |
| 80 | 220 | 2 | 3,5 | 5 | 6 |
| 220 | – | 2 | 3,8 | 6 | 7,2 |
| – | 280 | 2,1 | 4 | 6,5 | 7,8 |
| 280 | – | 2,1 | 4,5 | 7 | 8,4 |
| – | 100 | 2,5 | 3,8 | 6 | 7,2 |
| 100 | 280 | 2,5 | 4,5 | 6 | 7,2 |
| 280 | – | 2,5 | 5 | 7 | 8,4 |
| – | 280 | 3 | 5 | 8 | 9,6 |
| 280 | – | 3 | 5,5 | 8 | 9,6 |
| – | – | 4 | 6,5 | 9 | 10,8 |
| – | – | 5 | 8 | 10 | 12 |
| – | – | 6 | 10 | 13 | 15,6 |

Spindle bearings M, HCM, VCM or with suffix DLR have a reduced tolerance of the maximum chamfer dimensions.

15 Chamfer dimensions of radial bearings with tapered bore

| Chamfer dimension | | | Measurement spacing |
|---|---|---|---|
| – | radial | axial | |
| $r_{min}$<br>$r_{1\,min}$ | $r_{max\,r}$ | $r_{max\,a}$<br>$r_{1\,max\,a}$ | a |
| mm | mm | mm | mm |
| 0,05 | 0,15 | 0,25 | 0,8 |
| 0,1 | 0,3 | 0,5 | 1 |
| 0,15 | 0,45 | 0,75 | 1,3 |
| 0,2 | 0,6 | 1 | 1,5 |
| 0,25 | 0,75 | 1,25 | 1,8 |
| 0,3 | 0,9 | 1,5 | 2 |
| 0,35 | 1,05 | 1,75 | 2,3 |
| 0,4 | 1,2 | 2 | 2,5 |
| 0,45 | 1,35 | 2,25 | 2,8 |
| 0,5 | 1,5 | 2,5 | 3 |
| 0,55 | 1,65 | 2,75 | 3,3 |
| 0,6 | 1,8 | 3 | 3,5 |
| 0,7 | 2,1 | 3,5 | 4,2 |
| 0,8 | 2,4 | 4 | 4,8 |
| 0,9 | 2,7 | 4,5 | 5,4 |
| 1 | 3 | 5 | 6 |
| 1,1 | 3,3 | 5,5 | 6,6 |
| 1,2 | 3,6 | 6 | 7,2 |
| 1,5 | 4,5 | 7,5 | 9 |
| 1,8 | 5,5 | 9 | 10,8 |
| 2,2 | 6,5 | 11 | 13,2 |
| 3 | 9 | 15 | 18 |

16 Chamfer dimensions of axial bearings

| Chamfer dimension | | | Measurement spacing |
|---|---|---|---|
| – | radial | axial | |
| $r_{min}$<br>$r_{1\,min}$ | $r_{max\,r}$ | $r_{max\,a}$<br>$r_{1\,max\,a}$ | a |
| mm | mm | mm | mm |
| 0,1 | 0,2 | 0,2 | 0,7 |
| 0,15 | 0,3 | 0,3 | 0,8 |
| 0,2 | 0,5 | 0,5 | 1 |
| 0,3 | 0,8 | 0,8 | 1,3 |
| 0,6 | 1,5 | 1,5 | 2 |
| 1 | 2,2 | 2,2 | 2,6 |
| 1,1 | 2,7 | 2,7 | 3,2 |
| 1,5 | 3,5 | 3,5 | 4,2 |
| 2 | 4 | 4 | 4,8 |
| 2,1 | 4,5 | 4,5 | 5,4 |
| 3 | 5,5 | 5,5 | 6,6 |
| 4 | 6,5 | 6,5 | 7,8 |

### 1.2.3 Machining tolerances of adjacent parts

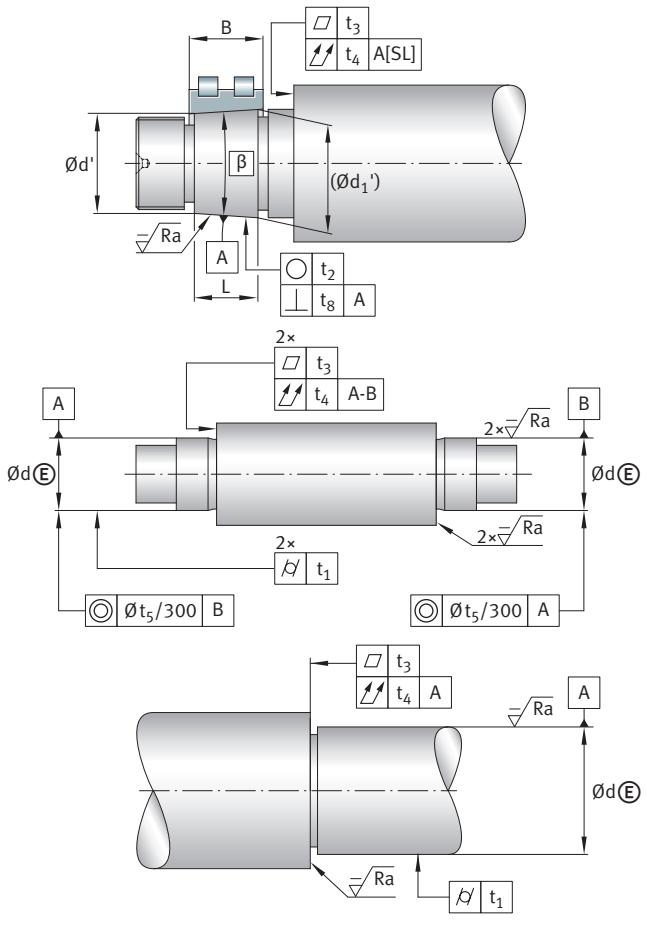
The performance capacity of super precision bearings in relation to speed suitability and running accuracy continues to increase. This increased performance capacity can only be used with adjacent parts that match the bearings in terms of precision.

In order to facilitate better and faster selection of fits as well as secure functioning and interchangeability of the super precision bearing, the dimensional, geometrical and positional tolerances that have proved effective in many applications are compiled in tables.

The mean roughness values Ra of the bearing seats must not be exceeded, in order that the recommended fits remain within a restricted change (burnishing). Furthermore, the generally valid rules of rolling bearing engineering that take account of the direction and action of loading, the rotation of the inner or outer ring and changes in the fit due to temperature and centrifugal force must be observed.

### 1.2.3.1 Geometrical and positional tolerances of the shaft

6 Geometrical and positional tolerances of the shaft




001A2330

| | | | |
|---|---|---|---|
| d | Nominal shaft diameter | d’ | Small taper diameter ( d + lower deviation) |
| $d_1$’ | Large taper diameter $d_1$’ = d’ +1/12· L | L | Taper length L = 0,95· B (bearing width) |
| $t_1$ | Cylindricity tolerance | $t_2$ | Roundness tolerance |
| $t_3$ | Flatness tolerance | $t_4$ | Total axial runout tolerance |
| $t_5$ | Coaxiality tolerance | $t_1$ ... $t_5$ | In accordance with DIN EN ISO 1101:2017 |
| $AT_D$ | Taper angle tolerance to DIN 7178 | Ra | Mean roughness value to DIN EN ISO 21920 |

In order to make comprehensive use of the performance capability of the bearings, the adjacent construction must be of an appropriate design.

Minimum requirements for the machining tolerances of the spindle bearing surrounding parts shafts are shown in the tables ➤24|▦17 ➤24|▦18 ➤25|▦19 ➤26|▦21.

▦17 Machining tolerances of the shaft for spindle bearings

| Nominal size | | Deviation for d | | Cylindricity | Flatness | Total axial runout | Coaxiality | Mean roughness |
|---|---|---|---|---|---|---|---|---|
| d | | | | $t_1$ | $t_3$ | $t_4$ | $t_5$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | | |
| – | 10 | 2 | –2 | 0,6 | 0,6 | 1 | 2,5 | 0,2 |
| 10 | 18 | 2,5 | –2,5 | 0,8 | 0,8 | 1,2 | 3 | 0,2 |
| 18 | 30 | 3 | –3 | 1 | 1 | 1,5 | 4 | 0,2 |
| 30 | 50 | 3,5 | –3,5 | 1 | 1 | 1,5 | 4 | 0,2 |
| 50 | 80 | 4 | –4 | 1,2 | 1,2 | 2 | 5 | 0,4 |
| 80 | 120 | 5 | –5 | 1,5 | 1,5 | 2,5 | 6 | 0,4 |
| 120 | 180 | 6 | –6 | 2 | 2 | 3,5 | 8 | 0,4 |
| 180 | 250 | 7 | –7 | 3 | 3 | 4,5 | 10 | 0,4 |
| 250 | 315 | 8 | –8 | 4 | 4 | 6 | 12 | 0,8 |
| 315 | 400 | 9 | –9 | 5 | 5 | 7 | 13 | 0,8 |
| 400 | 500 | 10 | –10 | 6 | 6 | 8 | 15 | 0,8 |
| 500 | 630 | 11 | –11 | 7 | 7 | 9 | 16 | 0,8 |
| 630 | 800 | 12 | –12 | 8 | 8 | 10 | 18 | 0,8 |

▦18 Machining tolerances of the cylindrical shaft for cylindrical roller bearings (tolerance class SP)

| Nominal size | | Deviation for d | | Cylindricity | Flatness | Total axial runout | Coaxiality | Mean roughness |
|---|---|---|---|---|---|---|---|---|
| d | | | | $t_1$ | $t_3$ | $t_4$ | $t_5$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | | |
| 18 | 30 | 3 | –3 | 1 | 1 | 1,5 | 4 | 0,2 |
| 30 | 50 | 3,5 | –3,5 | 1 | 1 | 1,5 | 4 | 0,2 |
| 50 | 80 | 4 | –4 | 1,2 | 1,2 | 2 | 5 | 0,4 |
| 80 | 120 | 5 | –5 | 1,5 | 1,5 | 2,5 | 6 | 0,4 |
| 120 | 180 | 6 | –6 | 2 | 2 | 3,5 | 8 | 0,4 |
| 180 | 250 | 7 | –7 | 3 | 3 | 4,5 | 10 | 0,4 |
| 250 | 315 | 8 | –8 | 4 | 4 | 6 | 12 | 0,8 |
| 315 | 400 | 9 | –9 | 5 | 5 | 7 | 13 | 0,8 |
| 400 | 500 | 10 | –10 | 6 | 6 | 8 | 15 | 0,8 |
| 500 | 630 | 11 | –11 | 7 | 7 | 9 | 16 | 0,8 |
| 630 | 800 | 12 | –12 | 8 | 8 | 10 | 18 | 0,8 |

19 Machining tolerances of the tapered shaft for cylindrical roller bearings (tolerance class SP)

| Nominal size | | Deviation of small taper diameter [1] | | Roundness | Flatness | Total axial runout | Mean roughness |
|---|---|---|---|---|---|---|---|
| d | | | | $t_2$ | $t_3$ | $t_4$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | |
| 18 | 30 | +73 | +64 | 1 | 1 | 1,5 | 0,2 |
| 30 | 40 | +91 | +80 | 1 | 1 | 1,5 | 0,2 |
| 40 | 50 | +108 | +97 | 1 | 1 | 1,5 | 0,2 |
| 50 | 65 | +135 | +122 | 1,2 | 1,2 | 2 | 0,2 |
| 65 | 80 | +159 | +146 | 1,2 | 1,2 | 2 | 0,2 |
| 80 | 100 | +193 | +178 | 1,5 | 1,5 | 2,5 | 0,2 |
| 100 | 120 | +225 | +210 | 1,5 | 1,5 | 2,5 | 0,2 |
| 120 | 140 | +266 | +248 | 2 | 2 | 3,5 | 0,2 |
| 140 | 160 | +298 | +280 | 2 | 2 | 3,5 | 0,2 |
| 160 | 180 | +328 | +310 | 2 | 2 | 3,5 | 0,2 |
| 180 | 200 | +370 | +350 | 3 | 3 | 4,5 | 0,2 |
| 200 | 225 | +405 | +385 | 3 | 3 | 4,5 | 0,2 |
| 225 | 250 | +445 | +425 | 3 | 3 | 4,5 | 0,2 |
| 250 | 280 | +498 | +475 | 4 | 4 | 6 | 0,4 |
| 280 | 315 | +548 | +525 | 4 | 4 | 6 | 0,4 |
| 315 | 355 | +615 | +590 | 5 | 5 | 7 | 0,4 |
| 355 | 400 | +685 | +660 | 5 | 5 | 7 | 0,4 |
| 400 | 450 | +767 | +740 | 6 | 6 | 8 | 0,4 |
| 450 | 500 | +847 | +820 | 6 | 6 | 8 | 0,4 |
| 500 | 560 | +928 | +900 | 7 | 7 | 9 | 0,4 |
| 560 | 630 | +1008 | +980 | 7 | 7 | 9 | 0,4 |
| 630 | 710 | +1092 | +1060 | 8 | 8 | 10 | 0,4 |

[1] In relation to the nominal shaft diameter d (calculation example).

## Calculation example

For cylindrical roller bearings, the tolerance of the tapered shaft can be calculated according to the following example.

- bearing bore: 70 mm
- tolerance class: SP
- small taper diameter d':
  = d + lower deviation
  = 70 mm + 0,146 mm = 70,146 mm
- tolerance:
  = upper deviation – lower deviation
  = 0,159 mm – 0,146 mm = (+) 0,013 mm

The half taper angle tolerance $AT_D/2$ applies vertical to the axis and is defined as the half differential diameter.

20 Deviation of taper angle

| Nominal size | | Taper angle tolerance $AT_D/2$ | |
|---|---|---|---|
| $L_U$ | $L_O$ | $AT_{DU}/2$ | $AT_{DO}/2$ |
| mm | mm | µm | µm |
| over | incl. | | |
| 10 | 16 | 0,8 | 1,3 |
| 16 | 25 | 1 | 1,6 |
| 25 | 40 | 1,3 | 2 |
| 40 | 63 | 1,6 | 2,5 |
| 63 | 100 | 2 | 3,2 |
| 100 | 160 | 2,5 | 4 |
| 160 | 250 | 3,2 | 5 |

For taper lengths with nominal dimensions that are between the values listed, the taper angle tolerance $AT_D/2$ is determined by means of interpolation. The recommended taper length L is 95 % of the bearing width.

For a single row cylindrical roller bearing N1014-D-TVP-SP-XL, the bearing width is 20 mm. The recommended taper length L is 19 mm (95 % of the bearing width).

1

$$AT_D/2 = \frac{\frac{AT_{DO}}{2} - \frac{AT_{DU}}{2}}{L_O - L_U} \cdot L$$

| | | |
|---|---|---|
| AT | µm | Taper angle tolerance |
| L | mm | Length |

2

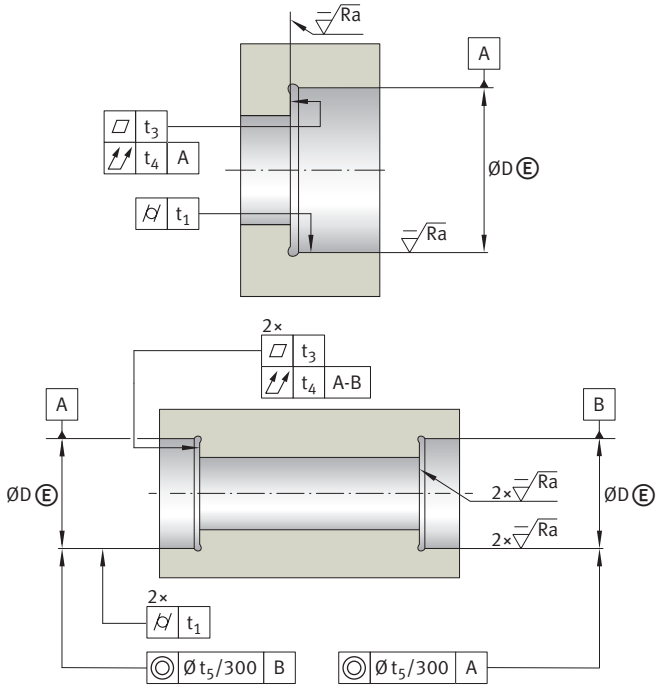
$$AT_D/2 = \frac{1,6-1}{25-16} \cdot 19 = 1,3\ \mu m$$

21 Machining tolerances of the shaft for axial angular contact ball bearings (tolerance class SP)

| Nominal size | | Deviation for d | | Cylindricity | Flatness | Total axial runout | Mean roughness |
|---|---|---|---|---|---|---|---|
| d | | | | $t_1$ | $t_3$ | $t_4$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | |
| 18 | 30 | 0 | −6 | 1 | 1 | 1,5 | 0,2 |
| 30 | 50 | 0 | −7 | 1 | 1 | 1,5 | 0,2 |
| 50 | 80 | 0 | −8 | 1,2 | 1,2 | 2 | 0,4 |
| 80 | 120 | 0 | −10 | 1,5 | 1,5 | 2,5 | 0,4 |
| 120 | 180 | 0 | −12 | 2 | 2 | 3,5 | 0,4 |
| 180 | 250 | 0 | −14 | 3 | 3 | 4,5 | 0,4 |
| 250 | 315 | 0 | −16 | 4 | 4 | 6 | 0,8 |
| 315 | 400 | 0 | −18 | 5 | 5 | 7 | 0,8 |
| 400 | 500 | 0 | −20 | 6 | 6 | 8 | 0,8 |

### 1.2.3.2 Geometrical and positional tolerances of the housing

7 Geometrical and positional tolerances of the housing




| | | | |
|---|---|---|---|
| D | Nominal housing bore diameter | $t_1$ | Cylindricity tolerance |
| $t_3$ | Flatness tolerance | $t_4$ | Total axial runout tolerance |
| $t_5$ | Coaxiality tolerance | $t_1$ ... $t_5$ | In accordance with DIN EN ISO 1101:2017 |
| Ra | Mean roughness value to DIN EN ISO 21920 | | |

22 Machining tolerances of the housing for spindle bearings

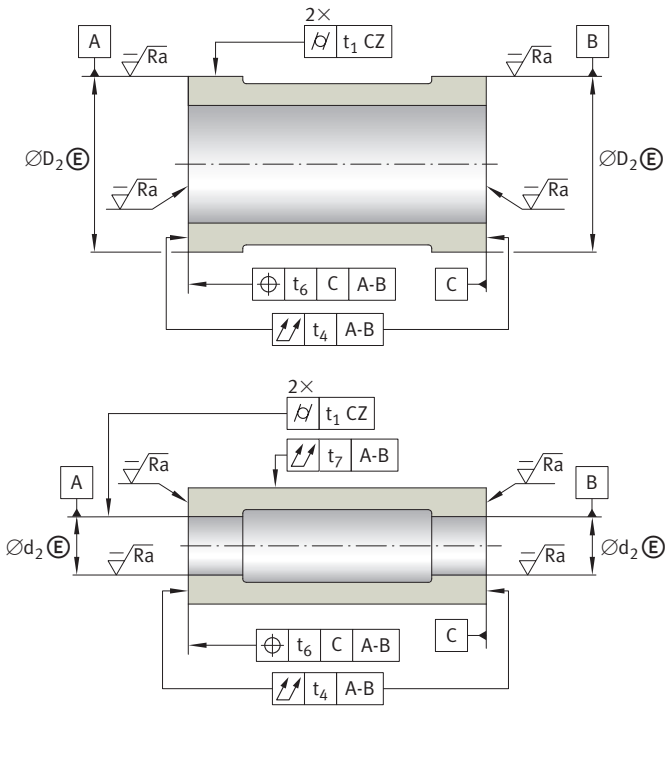
| Nominal size | | Deviation for D | | | | Cylindricity | Flatness | Total axial run-out | Coaxiality | Mean rough-ness value |
|---|---|---|---|---|---|---|---|---|---|---|
| D | | | | | | $t_1$ | $t_3$ | $t_4$ | $t_5$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | Locating bearing | | Non-locating bearing | | | | | | |
| 10 | 18 | +3 | −2 | +7 | +2 | 1,2 | 1,2 | 2 | 3 | 0,4 |
| 18 | 30 | +4 | −2 | +8 | +2 | 1,5 | 1,5 | 2,5 | 4 | 0,4 |
| 30 | 50 | +4 | −3 | +10 | +3 | 1,5 | 1,5 | 2,5 | 4 | 0,4 |
| 50 | 80 | +5 | −3 | +11 | +3 | 2 | 2 | 3 | 5 | 0,4 |
| 80 | 120 | +6 | −4 | +14 | +4 | 2,5 | 2,5 | 4 | 6 | 0,8 |
| 120 | 180 | +8 | −4 | +17 | +5 | 3,5 | 3,5 | 5 | 8 | 0,8 |
| 180 | 250 | +10 | −4 | +21 | +7 | 4,5 | 4,5 | 7 | 10 | 0,8 |
| 250 | 315 | +12 | −4 | +24 | +8 | 6 | 6 | 8 | 12 | 1,6 |
| 315 | 400 | +13 | −5 | +27 | +9 | 7 | 7 | 9 | 13 | 1,6 |
| 400 | 500 | +15 | −5 | +30 | +10 | 8 | 8 | 10 | 15 | 1,6 |
| 500 | 630 | +16 | −6 | +33 | +11 | 9 | 9 | 11 | 16 | 1,6 |
| 630 | 800 | +18 | −6 | +36 | +12 | 10 | 10 | 12 | 18 | 1,6 |
| 800 | 1000 | +21 | −7 | +42 | +14 | 11 | 11 | 14 | 21 | 1,6 |

23 Machining tolerances of the housing for super precision cylindrical roller bearings and axial angular contact ball bearings

| Nominal size | | Deviation for D | | Cylindricity | Flatness | Total axial runout | Coaxiality | Mean roughness |
|---|---|---|---|---|---|---|---|---|
| D | | | | $t_1$ | $t_3$ | $t_4$ | $t_5$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | | |
| 30 | 50 | +2 | −9 | 1,5 | 1,5 | 2,5 | 4 | 0,4 |
| 50 | 80 | +3 | −10 | 2 | 2 | 3 | 5 | 0,4 |
| 80 | 120 | +2 | −13 | 2,5 | 2,5 | 4 | 6 | 0,8 |
| 120 | 180 | +3 | −15 | 3,5 | 3,5 | 5 | 8 | 0,8 |
| 180 | 250 | +2 | −18 | 4,5 | 4,5 | 7 | 10 | 0,8 |
| 250 | 315 | +3 | −20 | 6 | 6 | 8 | 12 | 1,6 |
| 315 | 400 | +3 | −22 | 7 | 7 | 9 | 13 | 1,6 |
| 400 | 500 | +2 | −25 | 8 | 8 | 10 | 15 | 1,6 |
| 500 | 630 | 0 | −29 | 9 | 9 | 11 | 16 | 1,6 |
| 630 | 800 | 0 | −32 | 10 | 10 | 12 | 18 | 1,6 |
| 800 | 1000 | 0 | −36 | 11 | 11 | 14 | 21 | 1,6 |

### 1.2.3.3 Geometrical and positional tolerances of spacer sleeves

8 Geometrical tolerances and positional tolerances of spacer sleeves




| | | | |
|---|---|---|---|
| $d_2$ | Nominal spacer sleeve bore diameter | $D_2$ | Nominal spacer sleeve outside diameter |
| $t_1$ | Cylindricity tolerance | $t_4$ | Total runout tolerance |
| $t_6$ | Positional tolerance | $t_7$ | Total runout tolerance |
| $t_1$ ... $t_7$ | In accordance with DIN EN ISO 1101:2017 | Ra | Mean roughness value to DIN EN ISO 1302 |

Unless stated otherwise in the drawing, both spacer sleeves should be of the same length. The end faces of both sleeves should therefore be finish ground in a single clamping operation.

24 Machining tolerances of the inner spacer sleeve

| Nominal size | | Deviation for $d_2$ | | Cylindricity | Total axial runout | Parallelism | Radial runout | Mean roughness [1] |
|---|---|---|---|---|---|---|---|---|
| $d_2$ | | | | $t_1$ | $t_4$ | $t_6$ | $t_7$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | | |
| – | 10 | 9 | 0 | 2,5 | 1 | 1 | 2,5 | 0,4 |
| 10 | 18 | 11 | 0 | 3 | 1,2 | 1,2 | 3 | 0,4 |
| 18 | 30 | 13 | 0 | 4 | 1,5 | 1,5 | 4 | 0,4 |
| 30 | 50 | 16 | 0 | 4 | 1,5 | 1,5 | 4 | 0,4 |
| 50 | 80 | 19 | 0 | 5 | 2 | 2 | 5 | 0,4 |
| 80 | 120 | 22 | 0 | 6 | 2,5 | 2,5 | 6 | 0,8 |
| 120 | 180 | 25 | 0 | 8 | 3,5 | 3,5 | 8 | 0,8 |
| 180 | 250 | 29 | 0 | 10 | 4,5 | 4,5 | 10 | 0,8 |
| 250 | 315 | 32 | 0 | 12 | 6 | 6 | 12 | 1,6 |
| 315 | 400 | 36 | 0 | 13 | 7 | 7 | 13 | 1,6 |
| 400 | 500 | 40 | 0 | 15 | 8 | 8 | 15 | 1,6 |
| 500 | 630 | 44 | 0 | 16 | 9 | 9 | 16 | 1,6 |
| 630 | 800 | 50 | 0 | 18 | 10 | 10 | 18 | 1,6 |

1) Including end faces.

25 Machining tolerances of the outer spacer sleeve

| Nominal size | | Deviation for $D_2$ | | Cylindricity | Total axial runout | Parallelism | Mean roughness [2] |
|---|---|---|---|---|---|---|---|
| $D_2$ | | | | $t_1$ | $t_4$ | $t_6$ | Ra |
| mm | mm | µm | µm | µm | µm | µm | µm |
| over | incl. | | | | | | |
| 10 | 18 | –6 | –17 | 3 | 2 | 1,2 | 0,4 |
| 18 | 30 | –7 | –20 | 4 | 2,5 | 1,5 | 0,4 |
| 30 | 50 | –9 | –25 | 4 | 2,5 | 1,5 | 0,4 |
| 50 | 80 | –10 | –29 | 5 | 3 | 2 | 0,4 |
| 80 | 120 | –12 | –34 | 6 | 4 | 2,5 | 0,8 |
| 120 | 180 | –14 | –39 | 8 | 5 | 3,5 | 0,8 |
| 180 | 250 | –15 | –44 | 10 | 7 | 4,5 | 0,8 |
| 250 | 315 | –17 | –49 | 12 | 8 | 6 | 1,6 |
| 315 | 400 | –18 | –54 | 13 | 9 | 7 | 1,6 |
| 400 | 500 | –20 | –60 | 15 | 10 | 8 | 1,6 |
| 500 | 630 | –22 | –66 | 16 | 11 | 9 | 1,6 |
| 630 | 800 | –24 | –74 | 18 | 12 | 10 | 1,6 |
| 800 | 1000 | –27 | –83 | 21 | 14 | 11 | 1,6 |

2) Including end faces.

### 1.2.3.4 Fit tolerances for spindle bearings

FAG spindle bearings are suitable for the highest speeds. If grease lubrication is used, it is possible to achieve speed parameters of $n \cdot d_m$ to 2,1 $10^6$ $min^{-1} \cdot mm$, and, in the case of oil lubrication, even 3,3 $10^6$ $min^{-1} \cdot mm$ and higher.

These speeds induce high centrifugal forces that act on the inner rings and cause their expansion. Such expansion of the ring leads to the inner ring lifting off the shaft and thus to clearance between the inner ring and shaft.

This may have the following consequences:

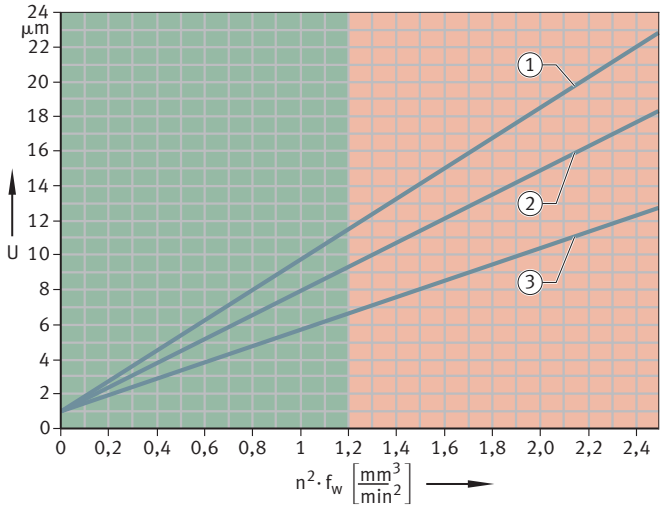
- fretting corrosion
- rotation of the ring on the shaft
- poor shaft guidance with an increased tendency towards vibration
- reduced bearing performance due to possible tilting

This can be prevented by correspondingly tight fits on the shaft. The necessary interference can be taken from the diagram or calculated using Bearinx. The values calculated in this way will give a fit under which there will still be interference of 1 µm at the highest speed.

High interference leads, particularly in the case of rigidly adjusted bearings, to an increase in preload. In turn, this leads to increased temperature in the bearing arrangement and to impaired speed capacity. The increase in preload must be compensated by means of appropriate measures.

At values $f_w \cdot n^2 > 1{,}2$ (red area), it is recommended that advise should be obtained from the Application Engineering facilities of the Schaeffler Group.

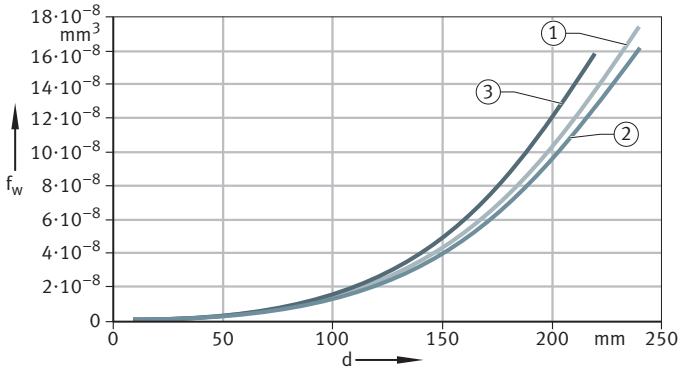
9 Calculation of the interference between the shaft and inner ring




00019529

| | | | |
|---|---|---|---|
| U | Interference, as a function of speed | n | Speed |
| $f_w$ | Factor for determining the fit | | |
| 1 | Solid shaft | 2 | Hollow shaft 50 % |
| 3 | Hollow shaft 75 % | | |

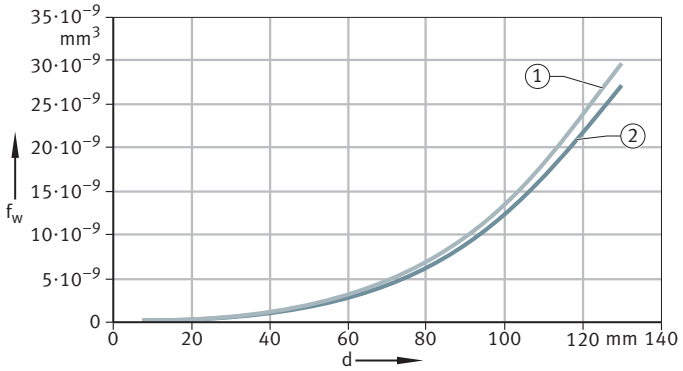
10 Factor $f_W$ for B, HCB




000B6555

| | | | |
|---|---|---|---|
| $f_W$ | Factor for determining the fit between the inner ring and shaft, as a function of speed | d | Bearing bore |
| 1 | B70, HCB70 | 2 | B719, HCB719 |
| 3 | B72, HCB72 | | |

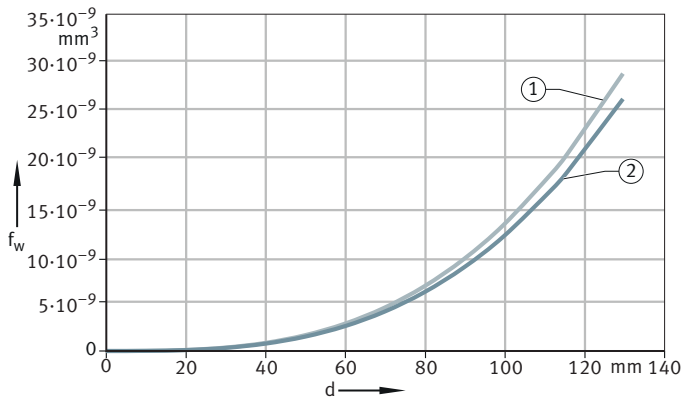
11 Factor $f_W$ for HS, HC




000B655E

| | | | |
|---|---|---|---|
| $f_W$ | Factor for determining the fit between the inner ring and shaft, as a function of speed | d | Bearing bore |
| 1 | HS70, HC70 | 2 | HS719, HC719 |

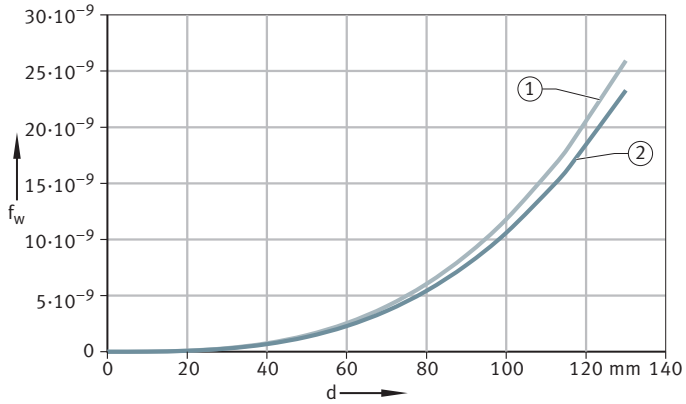
12 Factor $f_w$ for M, HCM




001A84F1

| | | | |
|---|---|---|---|
| $f_w$ | Factor for determining the fit between the inner ring and shaft, as a function of speed | d | Bearing bore |
| 1 | M70, HCM70 | 2 | M719, HCM719 |

13 Factor $f_w$ for VCM




001A8501

| | | | |
|---|---|---|---|
| $f_w$ | Factor for determining the fit between the inner ring and shaft, as a function of speed | d | Bearing bore |
| 1 | VCM70 | 2 | VCM719 |

**Example:**

If $f_w \cdot n^2 < 1{,}2$, the shaft dimension is calculated as follows:

- Spindle bearing
  - HCS71914-E-T-P4S-UL
- Speed n
  - 16000 $min^{-1}$
- Inner ring actual dimension (the deviation from the actual dimension is indicated on the bearing ring)
  - 70 mm – 3 µm = 69,997 mm
- Bore of hollow shaft
  - 35 mm (approx. 50 % of the diameter)
- Factor for determining the fit, as a function of the speed
  - $f_w = 4{,}30 \cdot 10^{-9}$
- $n^2 \cdot f_w = 1{,}1$

With the value 1,1 and the illustrated curve, the necessary interference is calculated as 9 µm.

The actual dimension of the shaft must thus be 70,006 mm, in order that the inner ring is still firmly seated on the shaft at a speed of n = 16000 $min^{-1}$.

### 1.2.3.5 Radial internal clearance for super precision cylindrical roller bearings and axial bearings (2344)

The values in the table are valid for single and double row cylindrical roller bearings with a tapered or cylindrical bore.

The internal clearance groups conform to DIN 620-4. The radial internal clearance is listed without the measurement load. Bearings of accuracy SP have a radial internal clearance C1. The bearing rings are not interchangeable (NA). The internal clearance groups C2, CN and C3 can be ordered using suffixes for the accuracy SP. The bearing rings are interchangeable.

26 Radial internal clearance, tapered bore

| Nominal size | | Internal clearance group | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| d | | C1 | | C2 | | CN | | C3 | |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. |
| 24 | 30 | 15 | 25 | 20 | 45 | 35 | 60 | 45 | 70 |
| 30 | 40 | 15 | 25 | 20 | 45 | 40 | 65 | 55 | 80 |
| 40 | 50 | 17 | 30 | 25 | 55 | 45 | 75 | 60 | 90 |
| 50 | 65 | 20 | 35 | 30 | 60 | 50 | 80 | 70 | 100 |
| 65 | 80 | 25 | 40 | 35 | 70 | 60 | 95 | 85 | 120 |
| 80 | 100 | 35 | 55 | 40 | 75 | 70 | 105 | 95 | 130 |
| 100 | 120 | 40 | 60 | 50 | 90 | 90 | 130 | 115 | 155 |
| 120 | 140 | 45 | 70 | 55 | 100 | 100 | 145 | 130 | 175 |
| 140 | 160 | 50 | 75 | 60 | 110 | 110 | 160 | 145 | 195 |
| 160 | 180 | 55 | 85 | 75 | 125 | 125 | 175 | 160 | 210 |
| 180 | 200 | 60 | 90 | 85 | 140 | 140 | 195 | 180 | 235 |
| 200 | 225 | 60 | 95 | 95 | 155 | 155 | 215 | 200 | 260 |
| 225 | 250 | 65 | 100 | 105 | 170 | 170 | 235 | 220 | 285 |
| 250 | 280 | 75 | 110 | 115 | 185 | 185 | 255 | 240 | 310 |
| 280 | 315 | 80 | 120 | 130 | 205 | 205 | 280 | 265 | 340 |
| 315 | 355 | 90 | 135 | 145 | 225 | 225 | 305 | 290 | 370 |
| 355 | 400 | 100 | 150 | 165 | 255 | 255 | 345 | 330 | 420 |
| 400 | 450 | 110 | 170 | 185 | 285 | 285 | 385 | 370 | 470 |
| 450 | 500 | 120 | 190 | 205 | 315 | 315 | 425 | 410 | 520 |
| 500 | 560 | 130 | 210 | 230 | 350 | 350 | 470 | 455 | 575 |
| 560 | 630 | 140 | 230 | 260 | 380 | 380 | 500 | 500 | 620 |
| 630 | 710 | 160 | 260 | 295 | 435 | 435 | 575 | 565 | 705 |

27 Radial internal clearance, cylindrical bore

| Nominal size | | Internal clearance group | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| d | | C1 | | C2 | | CN | | C3 | |
| mm | mm | µm | µm | µm | µm | µm | µm | µm | µm |
| over | incl. | min. | max. | min. | max. | min. | max. | min. | max. |
| 24 | 30 | 5 | 15 | 0 | 25 | 20 | 45 | 35 | 60 |
| 30 | 40 | 5 | 15 | 5 | 30 | 25 | 50 | 45 | 70 |
| 40 | 50 | 5 | 18 | 5 | 35 | 30 | 60 | 50 | 80 |
| 50 | 65 | 5 | 20 | 10 | 40 | 40 | 70 | 60 | 90 |
| 65 | 80 | 10 | 25 | 10 | 45 | 40 | 75 | 65 | 100 |
| 80 | 100 | 10 | 30 | 15 | 50 | 50 | 85 | 75 | 110 |
| 100 | 120 | 10 | 30 | 15 | 55 | 50 | 90 | 85 | 125 |
| 120 | 140 | 10 | 35 | 15 | 60 | 60 | 105 | 100 | 145 |
| 140 | 160 | 10 | 35 | 20 | 70 | 70 | 120 | 115 | 165 |
| 160 | 180 | 10 | 40 | 25 | 75 | 75 | 125 | 120 | 170 |
| 180 | 200 | 15 | 45 | 35 | 90 | 90 | 145 | 140 | 195 |
| 200 | 225 | 15 | 50 | 45 | 105 | 105 | 165 | 160 | 220 |
| 225 | 250 | 15 | 50 | 45 | 110 | 110 | 175 | 170 | 235 |
| 250 | 280 | 20 | 55 | 55 | 125 | 125 | 195 | 190 | 260 |
| 280 | 315 | 20 | 60 | 55 | 130 | 130 | 205 | 200 | 275 |
| 315 | 355 | 20 | 65 | 65 | 145 | 145 | 225 | 225 | 305 |
| 355 | 400 | 25 | 75 | 100 | 190 | 190 | 280 | 280 | 370 |
| 400 | 450 | 25 | 85 | 110 | 210 | 210 | 310 | 310 | 410 |
| 450 | 500 | 25 | 95 | 110 | 220 | 220 | 330 | 330 | 440 |
| 500 | 560 | 25 | 100 | 120 | 240 | 240 | 360 | 360 | 480 |
| 560 | 630 | 30 | 110 | 140 | 260 | 260 | 380 | 380 | 500 |
| 630 | 710 | 30 | 130 | 145 | 285 | 285 | 425 | 425 | 565 |

## 1.3 Speeds

The achievable speeds are dependent on the overall energy balance in the system.

The decisive factors are:

- number of bearings
- arrangement of bearings
- the internal load (preload class)
- external load
- lubrication
- heat dissipation

### 1.3.1 Spindle bearings

The limiting speeds are based on elastically preloaded single bearings and are theoretical guide values. In practice, the actual speeds may deviate up or down from the guide values depending on the operating conditions. However, they give a general indication of the speed suitability under ideal conditions, i.e. under low load and when using elastically preloaded single bearings with good heat dissipation. The data for grease lubrication are valid when using the high speed grease in the correct quantity.

#### 1.3.1.1 Reduction factors

The speed limits stated are reduced in the case of bearings fitted with rigid preload or high preload, if the design call for a higher rigidity of the spindle, as well as in bearing pairs and bearing groups. The speeds must therefore be multiplied by reduction factors.

| **Arrangement of bearings** | **Bearing preload** | | |
|---|---|---|---|
| | **L** | **M** | **H** |
| | **Factor $f_r$** | | |
| Large bearing spacing | | | |
|  | 0,85 | 0,75 | 0,5 |
|  | 0,8 | 0,7 | 0,5 |
|  | 0,75 | 0,65 | 0,45 |
| Small bearing spacing | | | |
|  | 0,75 | 0,6 | 0,35 |
|  | 0,65 | 0,5 | 0,3 |
|  | 0,65 | 0,5 | 0,3 |
|  | 0,72 | 0,57 | 0,37 |
|  | 0,54 | 0,4 | 0,25 |

## 1.3.2 Super precision cylindrical roller bearings

The limiting speeds $n_G$ are valid for grease lubrication or for minimal quantity oil lubrication and must not be exceeded.

In the case of cylindrical roller bearings, the radial internal clearance after mounting must be selected in accordance with the maximum operating speed.

28 Achievable speeds for single row cylindrical roller bearings

| Clearance or preload | Maximum achievable speed |
|---|---|
| µm | $min^{-1}$ |
| –5 … 0 | ‹ 0,75 · $n_G$ grease |
| 0 (clearance-free) | 0,75 … 1,0 · $n_G$ grease |
| 0… 5 | 1,0 … 1,1 · $n_G$ grease |
| 0… 5 | 1,0 · $n_G$ oil |

29 Achievable speeds for double row cylindrical roller bearings

| Clearance or preload | | Maximum achievable speed |
|---|---|---|
| µm | mm | $min^{-1}$ |
| –5 … 0 | – | ‹ 0,50 · $n_G$ grease |
| – | $2 \cdot 10^{-5} \cdot d_M$ 1) | 0,50 … 0,75 · $n_G$ grease |
| – | $4 \cdot 10^{-5} \cdot d_M$ 1) | 0,75 … 1,0 · $n_G$ grease |
| – | $1 \cdot 10^{-4} \cdot d_M$ 1) | 1,0 · $n_G$ oil |

1) $d_M = (d + D)/2$
These values are guide values for ΔT up 5 K between the inner and outer ring. For use in applications with larger temperature differentials, for example in motor spindles, please consult Schaeffler Application Engineering.

## 1.4 Rigidity

The axial and radial rigidity of a bearing arrangement is dependent on the arrangement of the bearings and the preload. The rigidity of the complete system is determined not only by the rigidity of the bearing arrangement but also significantly by the rigidity of the shaft and housing. In the application, the rigidity can be increased by means of the mounting and operating conditions.

### 1.4.1 Axial rigidity

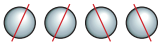
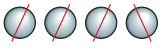
The axial rigidity $c_a$ is the quotient of the axial load and axial displacement.

$$c_a = \frac{F_a}{\delta_a} \quad (3)$$

| | | |
|---|---|---|
| $c_a$ | N/µm | Axial rigidity |
| $F_a$ | N | Axial load |
| $\delta_a$ | µm | Axial displacement |

The axial rigidity $c_a$ and the lift-off force $K_{aE}$ of a bearing set under a concentrically acting axial load is shown in the table.

30 Axial rigidity of spindle bearing sets

| Bearing arrangement | Axial rigidity | Lift-off force |
|---|---|---|
| | $c_a$ [1] | $K_{aE}$ |
| | N/µm | N |
|  | $c_a$ | $3 \cdot F_V$ |
|  | $1{,}64 \cdot c_a$ | $6 \cdot F_V$ |
|  | $2 \cdot c_a$ | $6 \cdot F_V$ |
|  | $2{,}24 \cdot c_a$ | $9 \cdot F_V$ |
|  | $2{,}64 \cdot c_a$ | $9 \cdot F_V$ |

[1] For values, see product tables.

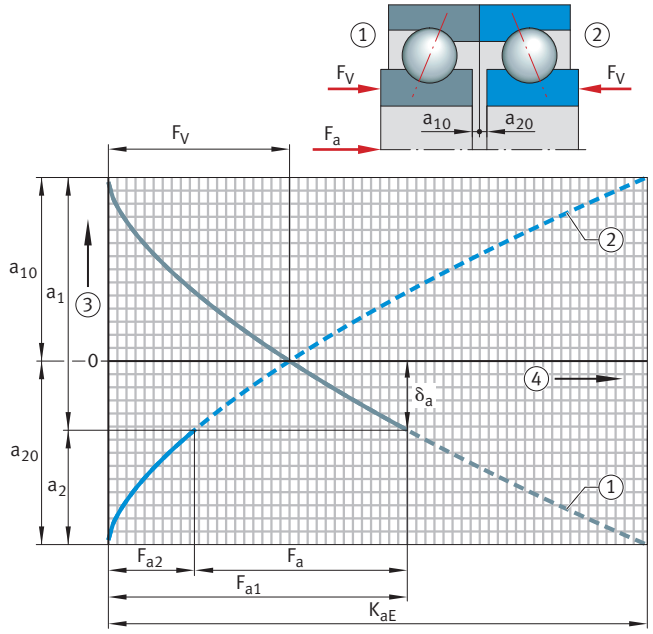
The deflection of a spindle bearing set is almost linear up to the lift-off force under which a bearing becomes free of load. The values stated in the produce tables for the axial rigidity $c_a$ are valid for bearing pairs in an O or X arrangement.

In sets with more than two bearings, there is an increase in the rigidity values and the lift-off force.

## 1.4.2 Lift-off force

The lift-off force $K_{aE}$ corresponds to an external axial load $F_a$ above which the preload ceases to have an effect. In the example, bearing 2 is relieved of load and is thus free of preload.

14 Preload force, axial load, lift-off force




00016E32

| | | | |
|---|---|---|---|
| $F_V$ | Preload force | $F_a$ | Axial force |
| $F_{a1}$ | Axial load on bearing 1 | $a_1$ | Deflection of bearing 1 |
| $a_{10}$ | Initial deflection of bearing 1 | $F_{a2}$ | Axial load on bearing 2 |
| $a_2$ | Deflection of bearing 2 | $a_{20}$ | Initial deflection of bearing 2 |
| $K_{aE}$ | Lift-off force | $\delta_a$ | Axial displacement |
| 1 | Bearing 1 | 2 | Bearing 2 |
| 3 | Deflection | 4 | Axial load |

## 1.4.3 Radial rigidity

f 4

$$c_r = \frac{F_r}{\delta_r}$$

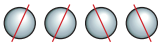
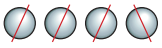
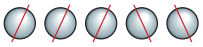
| | | |
|---|---|---|
| $c_r$ | N/µm | Radial rigidity |
| $F_r$ | N | Radial load |
| $\delta_r$ | µm | Axial displacement |

The radial rigidity $c_r$ can be calculated approximately from the axial rigidity $c_a$ using the following factors:

- $c_r \approx 6 \cdot c_a$ for $\alpha = 15°$
- $c_r \approx 5 \cdot c_a$ for $\alpha = 17°$
- $c_r \approx 2 \cdot c_a$ for $\alpha = 25°$

The radial rigidity $c_r$ for sets under a radial force acting at the centre of the set is calculated approximately from the radial rigidity of the bearing pair.

31 Radial rigidity of spindle bearing sets

| Bearing arrangement | Radial rigidity<br>$c_r$<br>N/µm |
|---|---|
|  | $c_r$ |
|  | $1,4 \cdot c_r$ |
|  | $2 \cdot c_r$ |
|  | $1,6 \cdot c_r$ |
|  | $2,7 \cdot c_r$ |

## 1.5 Load carrying capacity and operating life

### 1.5.1 Operating life of super precision bearings

Super precision bearings must guide machine parts with high precision and must support forces securely at very high speeds. The bearings are therefore selected predominantly according to the criteria of accuracy, rigidity and running behaviour.

In order that they can fulfil these tasks securely, they must run without wear. This requires the formation of a load-bearing hydrodynamic lubricant film at the contact points of the rolling contact partners. Under these conditions, the bearings can achieve their fatigue life in a large number of applications.

If the design is appropriate to the fatigue life, the operating life of the bearing is normally restricted by the lubricant operating life.

The decisive factors for the operating life from the perspective of load are the Hertzian pressures occurring at the contact points and the bearing kinematics. For high performance spindle bearings, it is therefore advisable to design the bearing arrangement individually using specific calculation programs.

#### 1.5.1.1 Fatigue strength

$$S_0^* = \frac{C_0}{P_0^*} \quad (5)$$

| | | |
|---|---|---|
| $S_0^*$ | – | Dynamic load safety factor (load ratio for fatigue strength) |
| $C_0$ | N | Basic static load rating |
| $P_0^*$ | N | Equivalent bearing load |

The equivalent load $P_0^*$ is calculated from the dynamic load forces in accordance with the equation for the equivalent static load.

For spindle bearings, the load ratio $S_0^*$ at which the essential precondition for fatigue strength is fulfilled is dependent on the series and the material used for the components.

A load ratio for super precision cylindrical roller bearings of $S_0^* \geq 8$ is an essential precondition for fatigue strength.

32 Load ratio

| Series | Contact angle α = 15° | | Contact angle α = 17° | | Contact angle α = 25° | |
|---|---|---|---|---|---|---|
| | $\frac{F_{0a}}{F_{0r}}$ 1,09 | $\frac{F_{0a}}{F_{0r}} > 1,09$ | $\frac{F_{0a}}{F_{0r}} \leq 1,13$ | $\frac{F_{0a}}{F_{0r}} > 1,13$ | $\frac{F_{0a}}{F_{0r}} \leq 1,3$ | $\frac{F_{0a}}{F_{0r}} > 1,3$ |
| B | 8 | 12 | – | – | 8 | 10 |
| HCB | 8 | 12 | – | – | 8 | 10 |
| HS | 8 | 12 | – | – | 8 | 10 |
| HC | 8 | 12 | – | – | 8 | 10 |
| M | – | – | 10 | 12 | 9 | 10 |
| HCM | – | – | 10 | 12 | 9 | 15 |
| VCM | – | – | 6 | 8 | 5 | 7 |

A more precise method is individual calculation of the Hertzian pressures and checking of the bearing kinematics using the Bearinx calculation program.

If the bearing fulfils the other preconditions for an effective separating lubricant film (viscosity ratio $\kappa \geq 2$) and very high cleanliness, calculation of the rating life $L_{10}$ in accordance with ISO 281 is not necessary.

If the bearing does not fulfil these preconditions, the influence of lubrication and contamination on the operating life can be estimated by carrying out manual calculation using an expanded rating life calculation in accordance with ISO 281 for manual calculation or in accordance with DIN 26281, for computer-aided methods.

### 1.5.1.2 Static load safety factor

In super precision bearings, static loading such as the tool ejection force is rarely checked.

Whether the static load carrying capacity of a bearing is sufficient for a given static load, can be checked with the aid of the static load safety factor $S_0$.

The parameter for static loading is the static load safety factor $S_0$.

$f$ 6

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

| | | |
|---|---|---|
| $S_0$ | – | Static load safety factor |
| $C_0$ | N | Basic static load rating |
| $P_0$ | N | Equivalent static bearing load |

In order to be able to utilise the high accuracy of the bearings, the static load safety factor $S_0$ must be as follows:

- spindle bearings: $S_0 > 2$
  - for hybrid bearings, only with short-term and concentrically acting axial load (tool ejection force). $S_0 \geq 1$
- super precision cylindrical roller bearings: $S_0 > 3$
- axial angular contact ball bearings: $S_0 > 2,5$

### 1.5.1.3 Equivalent static bearing load

The equivalent static bearing load $P_0$ is determined from the axial and radial loads acting on the bearing.

It induces the same load at the centre point of the most heavily loaded contact point between the rolling element and raceway as the combined bearing load occurring in practice. The load carrying capacity of the most heavily loaded bearing must be checked.

Universal bearings can support axial loads in one direction as well as radial loads.

33 Spindle bearings with contact angle 15°

| Load ratio | Equivalent static load |
|---|---|
| $\frac{F_{0a}}{F_{0r}} \leq 1{,}09$ | $P_0 = F_{0r}$ |
| $\frac{F_{0a}}{F_{0r}} > 1{,}09$ | $P_0 = 0{,}5 \cdot F_{0r} + 0{,}46 \cdot F_{0a}$ |

34 Spindle bearings with contact angle 17°

| Load ratio | Equivalent static load |
|---|---|
| $\frac{F_{0a}}{F_{0r}} \leq 1{,}13$ | $P_0 = F_{0r}$ |
| $\frac{F_{0a}}{F_{0r}} > 1{,}13$ | $P_0 = 0{,}5 \cdot F_{0r} + 0{,}44 \cdot F_{0a}$ |

35 Spindle bearings with contact angle 25°

| Load ratio | Equivalent static load |
|---|---|
| $\frac{F_{0a}}{F_{0r}} \leq 1{,}3$ | $P_0 = F_{0r}$ |
| $\frac{F_{0a}}{F_{0r}} > 1{,}3$ | $P_0 = 0{,}5 \cdot F_{0r} + 0{,}38 \cdot F_{0a}$ |

| | | |
|---|---|---|
| $F_{0a}$ | N | Largest axial load present (maximum load) |
| $F_{0r}$ | N | Largest radial load present (maximum load) |
| $P_0$ | N | Equivalent static bearing load |

Super precision cylindrical roller bearings can support radial forces only.

$f_{\square}7$

$$P_0 = F_{0r}$$

Axial angular contact ball bearings can support axial forces only.

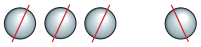
$f_{\square}8$

$$P_{0a} = F_{0a}$$

Where there are several bearings at one bearing position, the external load is distributed over the individual bearings. The load carrying capacity of the most heavily loaded bearing must be checked.

This must be based on the radial and axial loads acting on the specific bearing position, which must be calculated from the external loads and the spacings between the loading point and bearing positions.

36 Distribution of load

| Arrangement | Load component on most heavily loaded bearing | |
|---|---|---|
| | $F_a$ | $F_r$ |
| | % | % |
|  | 100 | 60 |
|  | 100 | 60 |
|  | 50 | 60 |
|  | 50 | 60 |
|  | 33 | 60 |
|  | 33 | 60 |

## 1.6 Lubrication

### 1.6.1 Principles

Lubrication and maintenance are important in order to achieve reliable function, an adequate operating life, wear-free running and a low vibration level in super precision bearings.

The following factors are essential preconditions for the formation of a lubricant film that separates the rolling contact partners at their contact points:

- presence of lubricant at all contact points and at all times
- definition of a lubrication method that is appropriate to the required speed
- selection of a lubricant with the correct characteristics

#### 1.6.1.1 Selection of the type of lubrication

It should be determined as early as possible in the design process whether bearings should be lubricated using grease or oil. The decisive factor is the maximum operating speed required.

This catalogue states, for each bearing, the maximum speeds for the two most important lubrication methods used with super precision bearings, which are grease lubrication and minimal quantity oil lubrication. These speeds are valid for single bearings and must be recalculated in the case of rigidly preloaded bearing arrangements by multiplication with the reduction factors ➤35|▦.

Grease lubrication is predominantly used in practice for super precision bearings.

This is a simple means of providing advantages such as:

- low friction
- lifetime lubrication
- very little design work required
- low system costs

Minimal quantity oil lubrication is used when the spindle speed is too high for grease lubrication. If high speed parameters are to be applied over long intervals, it may be advisable to use minimal quantity oil lubrication in order to achieve the required lubricant operating life. This may also be appropriate in those cases where grease lubrication would still be possible according to the achievable speed parameter for lubrication since the achievable grease operating life decreases with increasing speed ➤50|17.

#### 1.6.1.2 Optimised lubricants

In consideration of the bearing as a complete system, the lubricant plays an important role. The decision between grease and oil lubrication has a significant influence on the system costs.

The objective of Schaeffler is to facilitate and, as appropriate, drive forward the reliable application of grease lubrication up to very high speeds. Before a lubricant is approved for use in the bearing, it is subjected to a very stringent approval process. The calculations and suitability tests relating to the application-specific requirements, such as the temperature and running-in behaviour for a spindle running at high speed, are particularly important.

The result of this demanding process is an approved product specification for the particular lubricant and precise compliance with the specification is ensured by ongoing assessments.

#### 1.6.1.3 Lubricant viscosity

The condition of the lubricant film is determined by the viscosity ratio κ, which is defined as the quotient of the operating viscosity ν and the reference viscosity $\nu_1$.

*f 9*

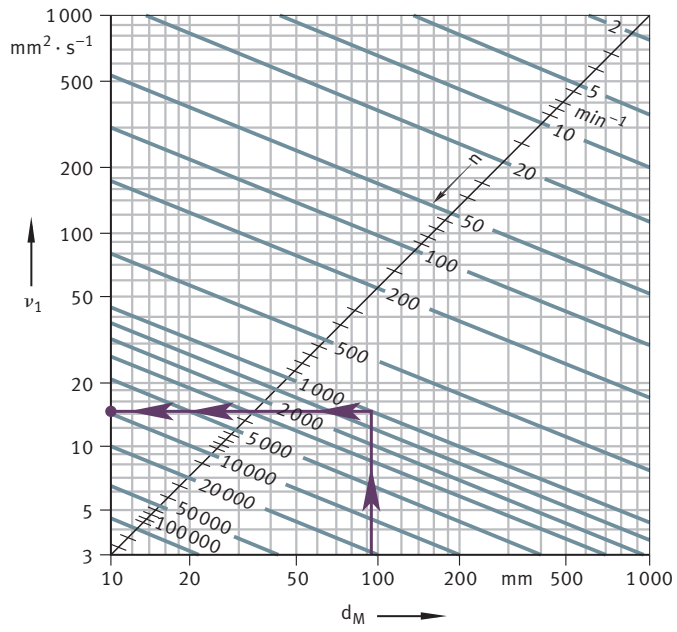
$$\kappa = \frac{\nu}{\nu_1}$$

| | | |
|---|---|---|
| κ | – | Viscosity ratio |
| ν | $mm^2/s$ | Kinematic viscosity of the lubricant at operating temperature |
| $\nu_1$ | $mm^2/s$ | Reference viscosity of the lubricant at operating temperature |

The operating viscosity is the actual viscosity of the lubricant during operation. It is a function of the operating temperature and the basic viscosity of the lubricant and can be determined from the V/T diagram.

In the case of greases, the viscosity of the base oil is used. For successful operation, the aim should be to achieve a viscosity at operating temperature that is at least twice as high as the reference viscosity, $\kappa = \nu/\nu_1 \geq 2$. Higher viscosity ratios do not give any further improvement in the lubricant film but do have the effect of increasing friction.

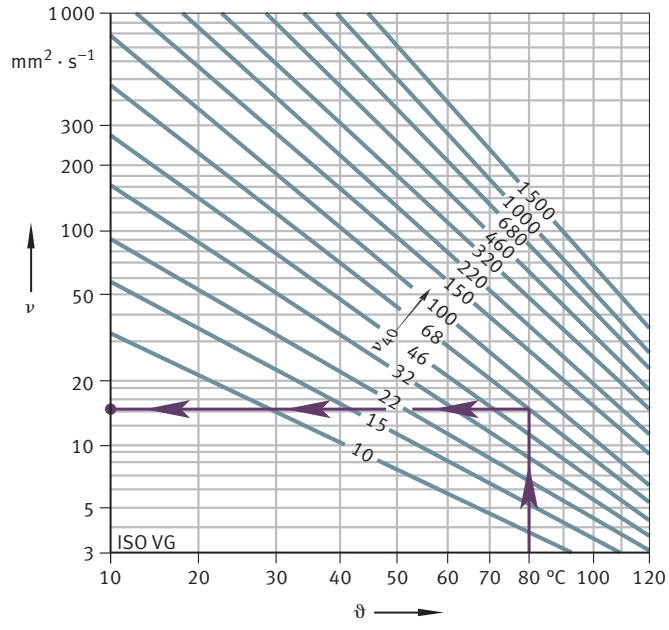
## 15 Reference viscosity $v_1$




00016C14

| | | | |
|---|---|---|---|
| $v_1$ | Reference viscosity | $d_M$ | Mean bearing diameter |
| n | Speed | | |

## 16 V/T diagram




00016C15

| | | | |
|---|---|---|---|
| v | Operating viscosity | θ | Operating temperature |
| $v_{40}$ | Viscosity at +40 °C | | |

## 1.6.2 Grease lubrication

Development in greases and bearings has led to an enormous improvement in performance, principally in relation to the achievable speeds. It is now possible to achieve speed parameters $n \cdot d_M$ of up to 2100000 $min^{-1} \cdot mm$.

The use of spindle bearings which are already supplied with lifetime lubrication and are already sealed brings further advantages, such as very high cleanliness, since the interior of the bearing is protected. It also gives simplified mounting.

### 1.6.2.1 Greases with special suitability

Many of the rolling bearings supplied by Schaeffler have a grease filling. In mechanical-dynamic tests, the greases used have proved particularly suitable for the application.

37 Greases for super precision bearings

| **Lubricating greases** | | **Designation** | | |
|---|---|---|---|---|
| | | **L252** | **L055** | **L298** |
| Identifier according to DIN 51825 | – | KHCP2/3K–40 | KPHC2N–30 | KPHCP3P–40 |
| Thickener | – | Lithium complex | Lithium | Polycarbamide |
| Base oil | – | PAO and ester oil | PAO and mineral oil | PAO and ester oil |
| Base oil viscosity at | +40 °C | 25 | 85 | 55 |
| | +100 °C | 5 | 12,5 | 9 |
| NLGI grade | – | 2 … 3 | 2 | 3 |
| Maximum operating temperature [1] | °C | 80 | 80 | 110 |
| Speed parameter $n \cdot d_M$ [2] | $min^{-1} \cdot mm$ | 2100000 | 800000 | 1300000 |
| Specific mass | ≈$g/cm^3$ | 0,94 | 0,9 | 0,86 |
| Application as | – | High speed grease | High pressure grease | High temperature grease |

1) Without minimisation of service life.

2) The speed parameter $n \cdot d_M$ is the product of the mean bearing diameter and the speed (values apply for point contact).

### L252

High speed greases have been developed for operation in spindles for machine tools. This class of greases includes the high speed grease L252. This grease is the current standard grease for spindle bearings, due to the achievable speeds and the suitability for the typical temperature range in machine tools. Grease L252 is available under the commercial name Arcanol SPEED2,6.

### L055

L055 is a high pressure grease that has proved effective in the end bearings of ball screw drives, in indexing table bearings and, for example, also in tailstock lathe centre bearing arrangements.

### L298

L298 is a high temperature grease that, due to its higher base oil viscosity, is used at continuous temperatures up to approx. +110 °C.

### GA21

In the case of sealed bearings supplied with standard greasing, the grease grade is not stated on the packaging or on the bearing. For open bearings that are supplied greased with high speed grease, markings on the bearing and on the packaging indicate application-specific grease group GA21. In the case of these bearings, Schaeffler reserves the right to change the grease grade without a change in designation on the precondition that the grease fulfils the requirements of the application-oriented grease group GA21 in relation to speed capacity, operating temperature and life.

### 1.6.2.2 Grease quantities

The individual bearing series require different grease quantities. The recommendations are matched to the space within the bearing that is not disturbed by rotating parts.

38 Recommended grease quantities for spindle bearings

| Bore code | Bearing series | | | | | | |
|---|---|---|---|---|---|---|---|
| | HS719, HC719 | HS70, HC70 | B719, HCB719 | B70, HCB70 | B72, HCB72 | M719, HCM719, VCM719 | M70, HCM70, VCM70 |
| | Grease quantity | | | | | | |
| | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ |
| 6 | – | 0,12 | – | 0,04 | – | – | – |
| 7 | – | 0,13 | – | 0,06 | – | – | – |
| 8 | – | 0,17 | – | 0,11 | – | – | – |
| 9 | – | 0,21 | – | 0,1 | – | – | – |
| 00 | 0,17 | 0,26 | 0,09 | 0,17 | 0,26 | – | – |
| 01 | 0,18 | 0,28 | 0,1 | 0,21 | 0,36 | – | – |
| 02 | 0,28 | 0,46 | 0,17 | 0,32 | 0,48 | – | – |
| 03 | 0,32 | 0,58 | 0,17 | 0,42 | 0,68 | – | – |
| 04 | 0,58 | 0,98 | 0,36 | 0,76 | 1,12 | – | – |
| 05 | 0,68 | 1,14 | 0,4 | 0,86 | 1,44 | 0,38 | 0,68 |
| 06 | 0,92 | 1,72 | 0,42 | 1,12 | 2,1 | 0,42 | 0,87 |
| 07 | 1,18 | 2,2 | 0,64 | 1,74 | 3 | 0,64 | 1,22 |
| 08 | 1,62 | 2,6 | 1,36 | 2,35 | 3,8 | 0,99 | 1,48 |
| 09 | 2,1 | 3,65 | 1,6 | 3 | 4,55 | 1,11 | 1,79 |
| 10 | 2,35 | 4 | 1,74 | 3,3 | 5,45 | 1,2 | 1,93 |
| 11 | 3,4 | 5,95 | 2,2 | 4,6 | 6,5 | 1,62 | 2,88 |
| 12 | 3,6 | 6,4 | 2,5 | 4,95 | 8 | 1,74 | 3,06 |
| 13 | 3,9 | 6,8 | 2,65 | 5,3 | 9,35 | 1,84 | 3,47 |
| 14 | 5,8 | 9,2 | 4,35 | 7,1 | 10,8 | 3,24 | 4,65 |
| 15 | 6,1 | 9,7 | 4,6 | 7,5 | 12,9 | 3,41 | 4,88 |
| 16 | 7 | 12,8 | 4,9 | 9,65 | 12,3 | 3,59 | 6,47 |
| 17 | 8,55 | 13,4 | 6,8 | 10,3 | 18,3 | 5 | 6,82 |
| 18 | 9,4 | 17,7 | 7,1 | 13,3 | 19,1 | 5,18 | 8,71 |
| 19 | 9,85 | 18,4 | 7,45 | 13,9 | 26,1 | 5,41 | 9,12 |
| 20 | 12,8 | 19,2 | 9,7 | 14,6 | 27,2 | 7,18 | 9,49 |
| 21 | 13,3 | 24,6 | 10,1 | 15 | 36,3 | 7,47 | 12,35 |
| 22 | 14,7 | 28,2 | 10,4 | 21,9 | 43,9 | 7,76 | 14,35 |
| 24 | 17,9 | 30,3 | 14,2 | 23,6 | 38,8 | 10,53 | 15,41 |
| 26 | 24 | 43,7 | 18,1 | 36,1 | 41,9 | 13,06 | 20,24 |
| 28 | 25,6 | 46,3 | 19,3 | 38,3 | 58,6 | – | – |
| 30 | 37,8 | 57,1 | 28,4 | 44,7 | 81,3 | – | – |
| 32 | 39,9 | 69,7 | 30 | 58,2 | 102,9 | – | – |
| 34 | – | – | 31,7 | 65,3 | 120,4 | – | – |
| 36 | – | – | 47,4 | 94,9 | 125,7 | – | – |
| 38 | – | – | 50 | 99,1 | 155,4 | – | – |
| 40 | – | – | 70,6 | 118,3 | 187,8 | – | – |
| 44 | – | – | 68,3 | 172,6 | 250,1 | – | – |
| 48 | – | – | 73,7 | 185,3 | – | – | – |
| 52 | – | – | 118,2 | 267 | – | – | – |
| 56 | – | – | 126 | 283,9 | – | – | – |
| 60 | – | – | 204,5 | – | – | – | – |

The spindle bearings HS and HC are available greased and sealed as HSS and HCS.

The spindle bearings B719, B70 and some bearings of series B72 as well as the corresponding hybrid designs are also available greased and sealed, design 2RSD. The spindle bearings M, HCM and VCM are also available greased and sealed, design 2RSD.

39 Recommended grease quantities for cylindrical roller bearings

| Bore code | Bearing series | | | | | |
|---|---|---|---|---|---|---|
| | N10-TVP-XL | N10-PVPA1-XL | N10-M1 | NN30-TVP-XL | NN30-M | NNU49-M |
| | Grease quantity | | | | | |
| | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ | $cm^3$ |
| 06 | 0,83 | – | 0,69 | 0,69 | 0,76 | – |
| 07 | 1,10 | – | 0,91 | 0,69 | 0,95 | – |
| 08 | 1,45 | 1,57 | 1,15 | 1,01 | 1,14 | – |
| 09 | 1,87 | 2,02 | 1,44 | 1,31 | 1,61 | – |
| 10 | 2,02 | 2,18 | 1,56 | 1,41 | 1,74 | – |
| 11 | 2,95 | 3,11 | 2,25 | 2,20 | 2,55 | – |
| 12 | 3,16 | 3,32 | 2,45 | 2,37 | 2,70 | – |
| 13 | 3,36 | 3,54 | 2,60 | 2,53 | 2,85 | – |
| 14 | 4,32 | 4,83 | 3,10 | 3,55 | 4,20 | 2,90 |
| 15 | 4,56 | – | 3,30 | 3,65 | 4,45 | 3,10 |
| 16 | 5,51 | – | 4,30 | 4,61 | 6,10 | 3,25 |
| 17 | 5,79 | – | 4,50 | 4,76 | 6,40 | 4,50 |
| 18 | 7,29 | 8,96 | 5,75 | 5,68 | 7,85 | 4,75 |
| 19 | 7,65 | – | 6,00 | 6,03 | 8,20 | 4,95 |
| 20 | 7,96 | 9,74 | 6,20 | 6,42 | 8,50 | 6,25 |
| 21 | 9,99 | – | 7,75 | 7,85 | 10,60 | 6,50 |
| 22 | 11,67 | – | 8,50 | 9,57 | 13,70 | 6,75 |
| 24 | 12,52 | – | 9,05 | 11,57 | 15,90 | 10,10 |
| 26 | – | – | 14,90 | – | 21,20 | 13,60 |
| 28 | – | – | 15,70 | – | 24,10 | 12,10 |
| 30 | – | – | 19,00 | – | 29,30 | 21,20 |
| 32 | – | – | 23,00 | – | 37,20 | 22,40 |
| 34 | – | – | 30,80 | – | 48,80 | 23,60 |
| 36 | – | – | 36,80 | – | 63,50 | 32,70 |
| 38 | – | – | 38,30 | – | 67,40 | 34,20 |
| 40 | – | – | 55,80 | – | 86,70 | 54,50 |
| 44 | – | – | 67,90 | – | 110,10 | 59,00 |
| 48 | – | – | 72,50 | – | 127,50 | 63,60 |
| 52 | – | – | 112,50 | – | 177,30 | 109,50 |
| 56 | – | – | 119,10 | – | 196,70 | 116,60 |

40 Recommended grease quantities double direction axial angular contact ball bearings

| Bore code | Bore diameter | Bearing series |
|---|---|---|
| | | 2344 |
| | | Grease quantity |
| | mm | $cm^3$ |
| 06 | 30 | 3,90 |
| 07 | 35 | 5,00 |
| 08 | 40 | 6,10 |
| 09 | 45 | 7,80 |
| 10 | 50 | 8,35 |
| 11 | 55 | 12,20 |
| 12 | 60 | 12,20 |
| 13 | 65 | 13,30 |
| 14 | 70 | 17,80 |
| 15 | 75 | 18,90 |
| 16 | 80 | 25,60 |
| 17 | 85 | 27,80 |
| 18 | 90 | 38,90 |
| 19 | 95 | 38,90 |
| 20 | 100 | 44,40 |
| 21 | 105 | 61,10 |
| 22 | 110 | 61,10 |
| 24 | 120 | 66,70 |
| 26 | 130 | 105,60 |
| 28 | 140 | 116,70 |
| 30 | 150 | 138,90 |
| 32 | 160 | 172,20 |
| 34 | 170 | 227,80 |
| 36 | 180 | 316,70 |
| 38 | 190 | 311,10 |
| 40 | 200 | 411,10 |
| 44 | 220 | 522,20 |
| 48 | 240 | 622,20 |
| 52 | 260 | 833,30 |
| 56 | 280 | 850,00 |

### 1.6.2.3 Grease operating life

The grease operating life is the period during which the lubricant introduced maintains the bearing function.

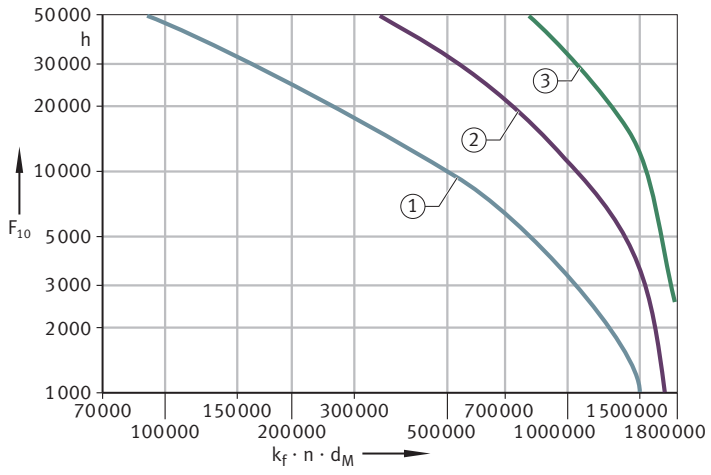
The grease operating life is dependent on the following factors:

- grease quantity
- grease type
- bearing type
- speed
- temperature
- mounting conditions
- operating conditions
- environmental conditions

The grease operating life $F_{10}$ must be taken into consideration as the decisive factor in many applications instead of the fatigue life.

The grease operating life is dependent on the bearing-specific speed parameter $k_f \cdot n \cdot d_M$.

17 Grease operating life $F_{10}$




| | | | |
|---|---|---|---|
| $F_{10}$ | Grease operating life | $k_f \cdot n \cdot d_M$ | Bearing-specific speed parameter |
| $k_f$ | Factor for bearing type | n | Operating speed or equivalent speed |
| $d_M$ | Mean bearing diameter | 1 | Steel bearing |
| 2 | Hybrid bearing | 3 | Hybrid bearing with Vacrodur rings |

41 Factor $k_f$, as a function of bearing type

| **Bearing type** | | **Factor $k_f$** |
|---|---|---|
| Spindle bearings with contact angle | 15° | 0,75 |
| | 17° | 0,75 |
| | 25° | 0,9 |
| Super precision cylindrical roller bearings | Single row | 1 |
| | Double row | 2 |
| Double direction axial angular contact ball bearings | | 2,5 |

Unfavourable operating and environmental conditions such as moisture, vibrations and air flows through the bearings must be taken into consideration as appropriate.

10

$$F_{10\ tot} = \frac{100}{\sum_{i=1}^{n} \frac{q_i}{F_{10\ i}}}$$

| | | |
|---|---|---|
| $F_{10\ tot}$ | h | Total grease operating life |
| n | – | Number of load cases |
| $q_i$ | % | Time periods |
| $F_{10\ i}$ | h | Grease operating life for individual speeds in speed duty cycle |

If a grease operating life › 3 is required, this should be discussed with the lubricant manufacturer.

#### 1.6.2.4 Grease distribution cycle

In order to distribute the grease, start/stop operation is recommended. This prevents high detrimental temperatures at the contact point. During the stop phase, the temperatures of the individual bearing components are levelled out, preventing detrimental increases in preload.

It is recommended that the temperature should be monitored during the grease distribution cycle as well as during the subsequent continuous running. The temperature sensor should be located as close as possible to the outer ring.

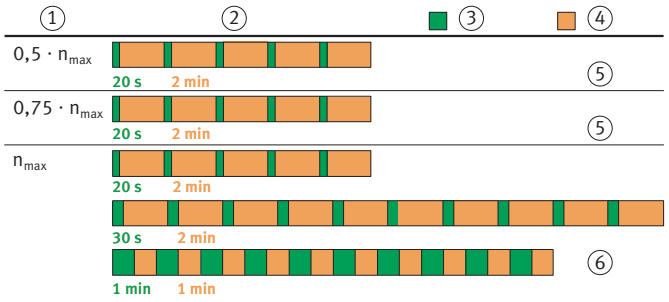
A progressive increase in temperature must be avoided at all costs. This will occur, for example, if there is an excessive increase in preload.

Grease distribution is completed once a stable bearing temperature has been achieved.

The running-in process comprises several cycles of start/stop operation at different speeds and for different running times, while the stationary times after each cycle are very important. The number of cycles required may vary according to the bearing size, the number of bearings, the maximum speed and the bearing environment.

Further cycles should be carried out for an increased running time and with a shortened stationary time until the equilibrium temperature is achieved.

18 Grease distribution cycle for open and sealed spindle bearings




| | | | |
|---|---|---|---|
| 1 | Speed | 2 | Running and stationary times |
| 3 | Running time | 4 | Stationary time |
| 5 | Time 11 min, 40 s | 6 | Time 56 min, 40 s |

### 1.6.3 Oil lubrication

For the lubrication of super precision bearings, fully synthetic oils with high pressure capacity are essentially suitable.

Oils in accordance with the designation ISO VG 68 + EP have proved effective here. This means that the oil has a nominal viscosity of 68 $mm^2/s$ at +40 °C and Extreme Pressure additives.

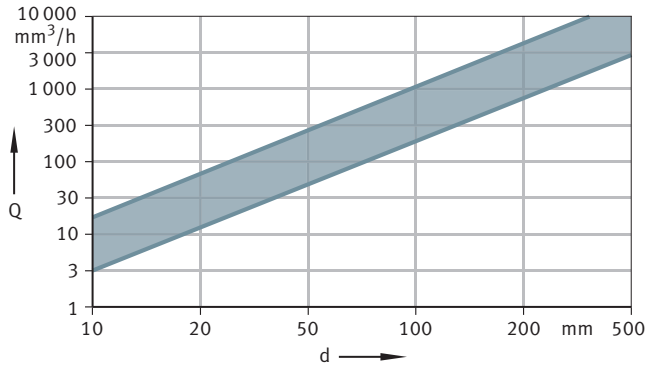
#### 1.6.3.1 Minimal quantity oil lubrication

Lubrication of FAG spindle bearings requires very little oil. Quantities of the order of magnitude of approx. 100 $mm^3/h$ are sufficient if it can be ensured that all the rolling and sliding surfaces are coated with oil. Such minimal quantity lubrication gives only small friction losses.

Minimal quantity oil lubrication is used when the spindle speed is too high for grease lubrication. The standard method is now pneumatic oil lubrication.

Specific flow conditions in the bearing arrangement can have a significant influence on the oil quantity. For hybrid bearings, the upper part of the range is always more applicable, while steel bearings tend to fall within the lower part of the range.

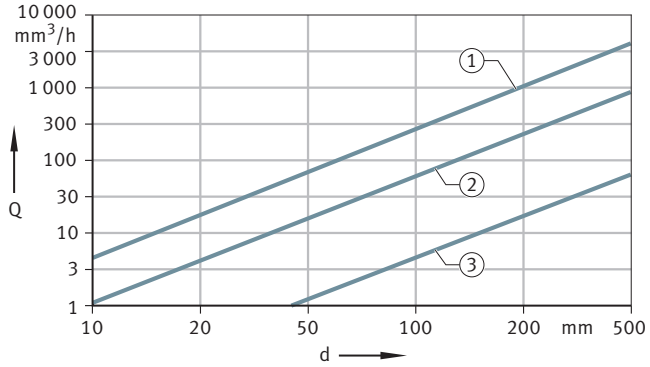
19 Oil quantity for spindle bearings with pneumatic oil lubrication




001A2554

| | | | |
|---|---|---|---|
| Q | Oil quantity | d | Bearing bore |

20 Oil quantity for cylindrical roller bearings with pneumatic oil lubrication




00019D35

| | | | |
|---|---|---|---|
| Q | Oil quantity | d | Bearing bore |
| 1 | Oil quantity for cylindrical roller bearings with ceramic rollers and ribs on the inner ring | 2 | Bearings with ribs on the inner ring and $n \cdot d_M \leq 10^6$ $min^{-1} \cdot mm$ |
| 3 | Bearings with ribs on the outer ring and $n \cdot d_M \leq 600000$ $min^{-1} \cdot mm$ | | |

Spindle bearings B, HCB, HS, HC, M, HCM and VCM are also available in the Direct Lube design.

42 Air quality

| Characteristic | Recommendation |
|---|---|
| Air cleanliness | Particle size ‹ 5 µm |
| Dryness of air | Dew point ‹ +3 °C |
| Air pressure in the feed pipe | ≈ 3 bar |
| Oil concentration | ‹ 1 mg/m³ |

Nozzle design:

- recommendation for nozzle diameter = 0,5 mm to 1 mm
- individual nozzles for each bearing
- one nozzle per 150 mm pitch circle circumference
- feed parallel to the spindle axis between the inner ring rib and cage bore
- for spindle bearings, feed from the load side of the outer ring to support the pumping action

Injection pitch circle diameter:

- injection pitch circle diameter $E_{tk}$
- in cylindrical roller bearings with a PVPA1 cage, two injection pitch circle diameters, depending on the injection side

Feed pipes:

- inside diameter 2 mm to 2,5 mm
- flexible and transparent plastic pipe, allowing visible oil flow on the inner wall of the pipe

Length:

- at least 1 m, optimally 4 m, up to approx. 10 m
- coiling with approx. 5 turns
- centre axis horizontal or inclined at an angle up to 30°
- not more than approx. 500 mm to the nozzle
- When lubrication is stopped, oil collects in the bottom of the turns and is rapidly available at restart. As a result, there is only a short delay when starting the spindle.

Oil outlets:

- on both sides of each bearing
- Accumulation of oil can cause hot running.
- In the case of vertical spindles, provide an outlet under each bearing so that the other bearings arranged below are not overlubricated. The diameter of the outlet hole should preferably be ≥ 5 mm.
- Connect all outlet holes from all bearings on one spindle in order to equalise pressures.

Further information can be obtained from the manufacturers of pneumatic oil lubrication devices.

43 Pneumatic oil lubrication devices

| **Oil quantities per injection cycle** | **Injection cycles per hour** |
|---|---|
| **$mm^3$** | |
| 3, 5, 10, (30, 60,100) | 6 to 10 times |

### 1.6.3.2 Requisite cleanliness

In super precision bearings, cleanliness at the contact surfaces plays an important role since contaminants strongly promote wear and thus reduce the operating life.

Guide values for lubricant cleanliness in bearings with oil lubrication are derived from hydraulic conditions and can be seen in the tables.

In bearings with grease lubrication, the highest level of cleanliness is present in practice if the bearings are already greased by the manufacturer and sealed by means of sealing washers.

44 Recommended oil purity classes with point contact

| (D – d)/2 | | Requisite oil purity class in accordance with ISO 4406 | Requisite filter retention rate in accordance with ISO 16889 | | Maximum size of overrolled particles [1] |
|---|---|---|---|---|---|
| mm | mm | | | | µm |
| over | incl. | | | | |
| – | 12,5 | 14/11/8 | $\beta_3 \geq$ | 200 | 10 |
| 12,5 | 20 | 15/12/9 | $\beta_3 \geq$ | 200 | 15 |
| 20 | 35 | 16/13/10 | $\beta_3 \geq$ | 200 | 25 |
| 35 | – | 17/14/11 | $\beta_3 \geq$ | 200 | 40 |

1) The data are correct if, in the heavily loaded area, no large particles with a hardness › 50 HRC are overrolled.

45 Recommended oil purity classes with line contact

| (D – d)/2 | | Requisite oil purity class in accordance with ISO 4406 | Requisite filter retention rate in accordance with ISO 16889 | | Maximum size of overrolled particles |
|---|---|---|---|---|---|
| mm | mm | | | | µm |
| over | incl. | | | | |
| – | 12,5 | 15/12/9 | $\beta_3 \geq$ | 200 | 15 |
| 12,5 | 20 | 16/13/10 | $\beta_3 \geq$ | 200 | 25 |
| 20 | 35 | 17/14/11 | $\beta_3 \geq$ | 200 | 40 |
| 35 | – | 17/14/11 | $\beta_3 \geq$ | 200 | 75 |

The oil purity class as an indicator of the probability of overrolling by life-reducing particles in the bearing can be determined using tests, for example by filter manufacturers and institutes. The purity classes are achieved when the total circulating oil quantity runs once through the filter in a few minutes.

A filter retention rate of $\beta_3 \geq 200$ means, for example, that only one out of 200 particles › 3 µm passes through the filter in the so-called multi-pass test.

Coarser filters can have detrimental consequences for the other subassemblies in the oil circuit. Before mounting of the bearing arrangement, the feed lines must be flushed in order to ensure good cleanliness.

## 1.7 Operating temperature

### 1.7.1 Spindle bearings

Spindle bearings are suitable for operating temperatures of –30 °C to +100 °C, restricted by the lubricant as well as the seal and cage material.

The FAG high performance grease of sealed spindle bearings is suitable up to a continuous temperature of +80 °C.

### 1.7.2 Super precision cylindrical roller bearings

The bearings are suitable for operating temperatures of –30 °C to +100 °C (or higher depending on the cage design).

### 1.7.3 Axial angular contact ball bearings

Axial angular contact ball bearings are suitable for operating temperatures of –30 °C to +150 °C.

Note the information on the operating temperatures of greases.

## 1.8 Design and examples of bearing arrangements

### 1.8.1 Design and applications

In practical application, a large number of different spindle bearing arrangements are used. The specific use in turning, milling and grinding or in high frequency motor spindles determines the selection and arrangement of spindle bearing arrangements. The design of the bearing arrangement is also influenced in relation to the bearing size and bearing type by the operating conditions. Finally, consideration of the cost-effectiveness of various technical design possibilities also plays a major role.

The bearing arrangement must run clearance-free and normally with preload in operation in order to fulfil the high accuracy requirements (P4 and above). In addition, very high speeds are required (with grease lubrication, up to $n \cdot d_M = 2{,}1 \cdot 10^6\ min^{-1} \cdot mm$ and with pneumatic oil lubrication, up to $n \cdot d_M = 3{,}3 \cdot 10^6\ min^{-1} \cdot mm$) at the lowest possible operating temperatures. These requirements call for the use of super precision bearings and correspondingly accurate adjacent parts.

The following guidelines serve to assist in the selection of bearings and bearing arrangements.

The following aspects are considered:

- preload
- rigidity
- bearing contact angle
- ball size and material
- distance between the bearings
- sealing
- stages in bearing arrangement design
- comparison of bearing arrangements
- examples of bearing arrangements

## 1.8.2 Preload

Rigidly adjusted bearing arrangements, specifically those with a short spacing between the bearings, react with a high degree of sensitivity to temperature differences between the shaft and housing. This may be because the preload within the bearing set can increase sharply or because the bearing sets may brace against each other if the sliding seat does not function.

Radial bracing may occur in particular with spindle bearings having a contact angle of 15°. This also applies to cylindrical roller bearings or non-locating bearing pairs with a sliding seat.

In contrast, rigid bearing arrangements with a large spacing between the bearings, elastically adjusted bearing arrangements and bearings with a contact angle of 17° or 25° are less sensitive.

Bearings with ceramic rolling elements generally have lower operating temperatures. Furthermore, the increase in the preload in the rigid system with increasing ΔT is smaller in this case than with steel balls.

For rigidly preloaded bearing arrangements, speed reduction factors must be applied.

In bearing arrangements adjusted by springs or hydraulic means, the stated speeds are achieved due to the lower thermal sensitivity. In bearings with a contact angle of 15° or 17°, the ΔT between the shaft and housing may restrict the speed.

For the springs, a preload force is selected that corresponds to at least the mean bearing preload M.

### 1.8.2.1 Axial angular contact ball bearings

In axial angular contact ball bearings, the preload is determined by the spacer ring arranged between the two shaft locating washers.

## 1.8.3 Rigidity

The rigidity of the bearing arrangement system is influenced by the shaft diameter, the number of bearings, the bearing size, the preload and the contact angle.

### 1.8.3.1 Contact angle and rigidity

The rigidity of a bearing set is dependent on the arrangement of the bearings and the preload. The rigidity of the complete system is determined not only by the rigidity of the bearing arrangement but also significantly by the rigidity of the shaft and housing.

Bearings with a contact angle of 15° or 17° have only 45 % or 50 % of the axial rigidity of bearings with a contact angle of 25°, but have greater radial rigidity.

If the spindle bearing and boom is considered as a complete system, the total rigidity of a bearing arrangement with 25° bearings is normally better in terms of radial displacement and tilting due to the wider support spacing than in a bearing arrangement with 15° bearings.

#### 1.8.3.2 Rigidity of a preloaded bearing arrangement

The rigidity of a rigidly preloaded bearing arrangement increases during mounting due to the influence of fit compared with the catalogue data. In operation, it increases further due to the expansion of the ring as a result of centrifugal force at high speeds and due to the thermally induced radial expansion of the shaft and inner ring.

### 1.8.4 Bearing contact angle

The available contact angles of the spindle bearings have different advantages and areas of application.

46 Contact angles, advantages and applications

| **Advantages and applications** | **Contact angle** | | |
|---|---|---|---|
| | **15°** | **17°** | **25°** |
| Advantages | • radial rigidity<br>• radial load carrying capacity<br>• higher speed at small ΔT<br>• kinematically insensitive to tilting | • radial rigidity<br>• radial and combined loads<br>• higher speeds at moderate ΔT<br>• kinematically insensitive to tilting | • axial rigidity<br>• radial system rigidity<br>• axial load carrying capacity<br>• combined axial and radial load carrying capacity<br>• high permissible ΔT between inner ring and outer ring |
| Applications | • grinding machines<br>• lathes<br>• precision machining equipment<br>• bearing arrangement on belt side | • milling at high output<br>• machining centres<br>• motor spindles | • milling machines<br>• drilling machines<br>• machining centres<br>• motor spindles |

### 1.8.5 Bearing selection according to ball size and material

Spindle bearings with a B in the designation are filled with large balls. Spindle bearings with an M in the designation are filled with medium-sized balls. Spindle bearings with an H in the designation have small balls.

Bearings with large balls have a higher load carrying capacity and are therefore more suitable for high loads than bearings with small balls. Bearings with small balls should be selected in preference for high speeds. Due to their optimised internal construction, the M bearings with medium-sized balls offer excellent speed suitability combined with a good load carrying capacity.

#### 1.8.5.1 Ceramic

Bearings with ceramic rolling elements have additional speed advantages and also offer a longer grease life.

#### 1.8.5.2 Specifications for bearing selection

Bearing selection is aided by a comparison of the specifications and performance data of spindle bearings.

47 Comparison of bearing designs

| Ball material | Ball size | Bearing type | Load carrying capacity | Speed suitability | Service life |
|---|---|---|---|---|---|
| Steel | Large | B | High | Medium | Good |
| Steel | Medium | M | High | High | Good |
| Steel | Small | HS | Medium | High | Better |
| Ceramic | Large | HCB | Medium | High | Much better |
| Ceramic | Medium | HCM | Medium | Highest | Much better |
| Ceramic | Small | HC | Low | Highest | Best |
| Ceramic | Medium | VCM | Premium | Premium | Premium |

### 1.8.6 Selection of the optimum bearing spacing

In rigidly preloaded bearing arrangements, it is recommended that a thermally neutral bearing spacing is selected at which the effects of the radial and axial thermal expansion of the shaft in relation to the influence on preload are compensated.

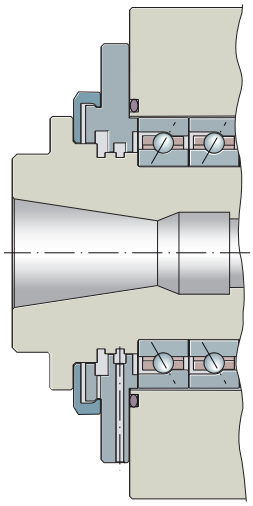
This thermally optimum bearing spacing L corresponds for spindle bearings with a 25° contact angle to approx. three times the shaft diameter d. In bearings with a 15° or 17° contact angle, L is approx. $5 \cdot d$, and it often takes too long for the axial thermal expansion to take effect due to the long bearing spacing. Such an approach is not very advisable in practice.

### 1.8.7 Sealing

Main spindle bearing arrangements must be effectively sealed, especially at the spindle nose. The high speeds call for a non-contact labyrinth seal with a protective collar, narrow radial gaps (to h8/C9), wide axial gaps (gap width ≥ 3 mm) outlet holes. The labyrinth seal must ensure complete sealing integrity against cooling lubricant, swarf and dust during rotation and at standstill.

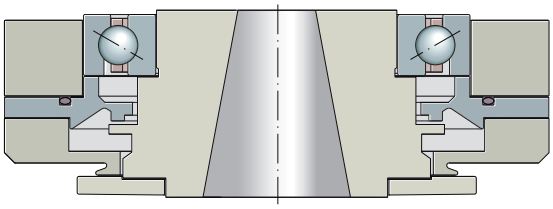
When using grease lubrication, sealed bearings assist the effect of the labyrinth and prevent air flows through the bearing arrangement.

21 Labyrinth seal for horizontal spindle



00016C36

22 Labyrinth seal for vertical spindle



001A874E

### 1.8.8 Stages in bearing arrangement design

In the design of a spindle bearing arrangement, the following stages must be performed:

1. Define the operating conditions (speeds, forces, time periods, spacings and diameters, temperatures, environmental influences).
2. Select the arrangement of bearings on the basis of the application and the requirements ➤63|▦49.
3. Determine the lubrication ➤42|1.6.
4. Select the bearing type and bearing size on the basis of speed suitability, design envelope and lubrication.
5. Check the grease operating life ➤50|17.
6. Calculate the load distribution on the bearings.
7. Check the fatigue strength of the bearing arrangement ➤39|1.5.1.1.

#### 1.8.8.1 Bearing design using a calculation program

If a calculation program is available, the following stages can also be performed:

- Calculate the bearing kinematics (spin/roll ratio, ball advance and ball retardation) and pressures ($p_0$) and compare with the design limits.
- Assess the rating life taking account of lubrication and cleanliness.
- Calculate the bending line, deflections and rigidity.
- Calculate the natural frequencies or critical whirling speeds.
- Optimise the bearing arrangement.

Schaeffler provides support with design and calculations by agreement. It is advisable in this case to submit the complete bearing arrangement data using the form for bearing arrangement calculations in the appendix of the catalogue. This form is also available for download at:
https://www.schaeffler.de/std/1FC6.

48 Design limits

| Criteria | Limit values | | |
|---|---|---|---|
| Spin/roll ratio | max. 0,5 | | |
| Maximum ball advance and ball retardation | Dependent on the internal design of the bearing | | |
| Hertzian pressures | Fatigue strength limits: | | |
| | Point contact with | 100Cr6: | 2000 MPa |
| | | Vacrodur: | 2700 MPa |
| | Line contact with | 100Cr6: | 1500 MPa |

### 1.8.9 Design of main spindles using Bearinx

#### 1.8.9.1 Assistance in rolling bearing design

As early as the development phase, Schaeffler offers its customers the support they require for the reliable application of super precision bearings.

A key component in design work is the design of the rolling bearings. For this purpose, Schaeffler has been successfully using calculation programs for more than 30 years.

The computer-aided examination of rolling bearing behaviour under realistically modelled operating conditions in the design phase helps to speed up development work and contributes to higher operational security.

#### 1.8.9.2 Bearinx – a leading calculation program

In Bearinx, Schaeffler has developed one of the leading programs for the calculation of rolling bearings. It facilitates the detailed analysis of rolling bearing arrangements, from individual bearings to complex shaft systems, transmissions and linear guidance systems. The complete calculation is carried out in a consistent calculation model. Even for extensive applications, the contact pressure at each individual rolling element is included in the calculation.

The current version of Bearinx includes a special module for calculation of spindle bearings. The functional scope of Bearinx incorporates the influences of centrifugal force on load distribution and the running behaviour of rolling elements in angular contact ball bearings.

Bearinx takes account of factors including:

- non-linear elastic deflection behaviour of the bearings
- elasticity of shafts and axes
- influence of fit, temperature and speed on the operating clearance or preload of the bearings and on their contact angle
- profiling of rollers and raceways as well as raceway osculations
- load-induced displacements in contact angle in ball bearings and angular contact ball bearings
- the influence of lubrication conditions, contamination and actual contact pressure on the fatigue life

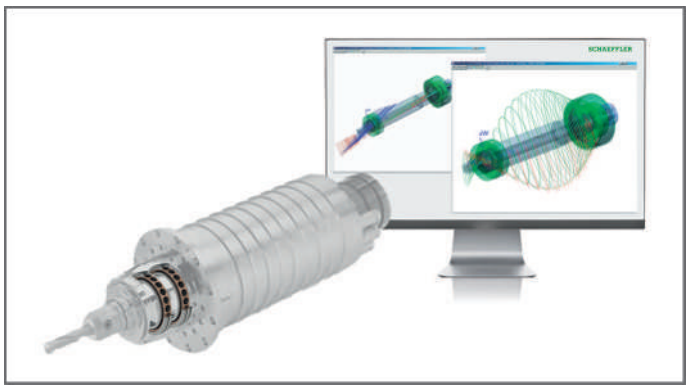
Bearinx thus offers the option of determining the load on spindle bearings that is representative of reality.

#### 1.8.9.3 Spindle calculation using Bearinx

The spindle calculation using Bearinx offers:

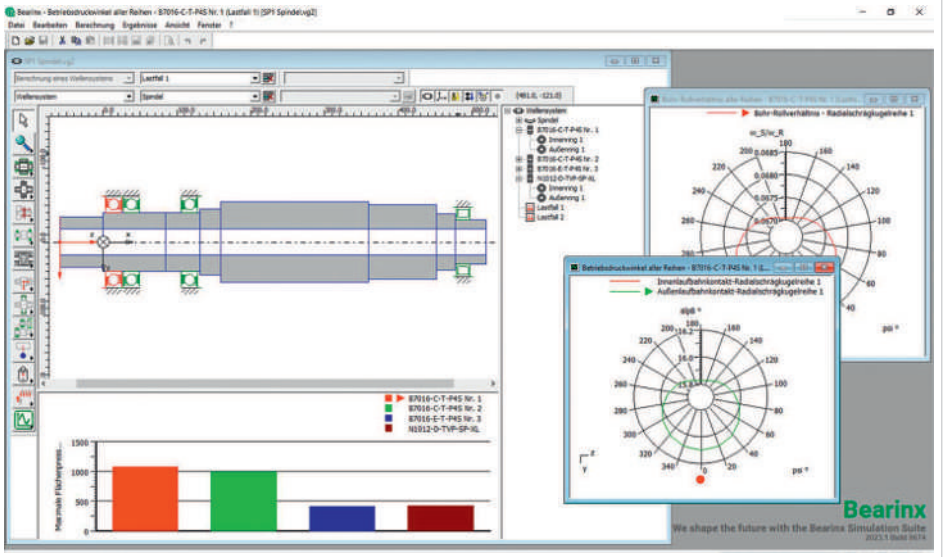
- recommendations for mounting fits as a function of the specified speed
- calculation of design parameters for contact pressure and kinematics in the bearing
- kinematic bearing frequencies for vibration analyses
- calculation of the rigidity of the bearing arrangement at the operating point taking account of all relevant influences
- diagrammatic shaft responses such as shaft deflection and shaft inclination
- critical whirling speeds and the diagrammatic representation of the natural mode
- calculation of the fatigue life in accordance with DIN 26281
- many other pieces of additional information

23 Deflection of the shaft




001A2564

24 Calculation of the load distribution




001A878E

The Bearinx-online spindle calculation program is available to Schaeffler direct customers and Schaeffler sales partners:
https://medias.schaeffler.de/de/bearinxonlinespindlecalculation

The Bearinx-online spindle calculation allows calculations to be carried out for the provisional design of spindle bearing arrangements on a contractually agreed basis and following the completion of a two-day training course.

Bearinx-online uses the same calculation models and algorithms as those found in the full version of Bearinx, since both programs are based on the same source code. Calculation files created in Bearinx-online are compatible with the full version of Bearinx.

## 1.8.10 Comparison of bearing arrangements

The data are guide values, based on a spindle with the following:

- shaft diameter d = 70 mm
- bearing spacing L = 3 · d
- boom A = L/2

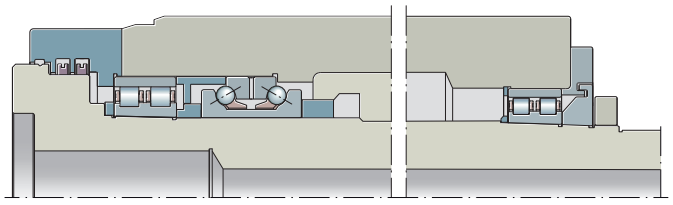
49 Comparison of applications and performance data

| Arrangement of bearings | | Typical application | Speed suitability | System rigidity | | Load carrying capacity | | Temperature behaviour | |
|---|---|---|---|---|---|---|---|---|---|
| front | rear | | % | % | | % | | Load | |
| | | | | axial | radial | axial | radial | Operating temperature | Sensitivity |
| ==▸◂ | == | Universal | 50 | 100 | 100 | 60 | 100 | + | + |
| ‹‹ ›› | == | Grinding | 72 | 65 | 100 | 75 | 50 | ++ | ++ |
| ‹‹ › | == | Turning | 65 | 44 | 86 | 75 | 47 | + | ++ |
| ‹‹ › | ‹ › | Turning, grinding | 65 | 44 | 84 | 75 | 44 | ++ | + |
| ‹ › | = | Wood, motor | 75 | 32 | 79 | 35 | 42 | +++ | +++ |
| ‹ › | ‹ › | Drilling, motor | 75 | 32 | 77 | 35 | 40 | +++ | +++ |
| ‹ | › | Milling, drilling | 85 | 30 | 62 | 35 | 22 | +++++ | +++++++ |
| ‹‹ | ›› | Milling, drilling, universal | 80 | 61 | 95 | 75 | 44 | ++++ | ++++++ |
| ‹‹‹ | ›› | Milling, drilling, universal | 75 | 76 | 98 | 100 | 46 | +++ | +++++ |
| ‹ | ≈› | Motor | 100 | 23 | 60 | 30 | 27 | +++++++ | +++++++ |
| ‹‹ | ≈›› | Motor | 100 | 46 | 92 | 60 | 52 | ++++++ | ++++++ |
| ‹ ≈› | ≈› | Motor | 100 | 25 | 89 | 25 | 60 | ++++++ | +++++++ |
| ‹ ≈› | = | Motor | 80 | 23 | 82 | 30 | 46 | ++++++ | ++++ |
| ‹‹ ≈› | ≈› | Motor | 100 | 46 | 93 | 50 | 65 | ++++++ | +++++ |
| ‹‹ ≈›› | ≈›› | Motor | 100 | 48 | 98 | 48 | 65 | ++++ | +++++ |

| | |
|---|---|
| 100 | Optimum |
| + | Very unfavourable |
| +++++ | Very good |
| ‹ | Spindle bearing |
| = | Single row cylindrical roller bearing |
| == | Double row cylindrical roller bearing |
| ▸◂ | Double direction axial angular contact ball bearing |
| ≈ | Spring |

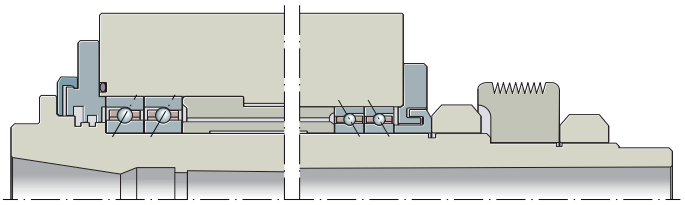
## 1.8.11 Examples of bearing arrangements

25 Milling spindle for high loads



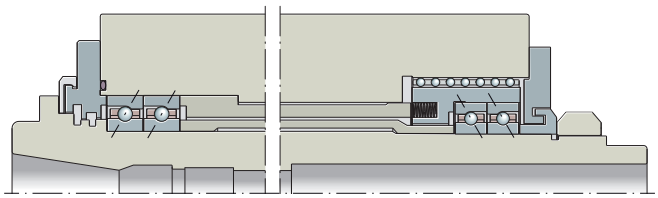
001A87C1

26 Milling spindle for high speeds



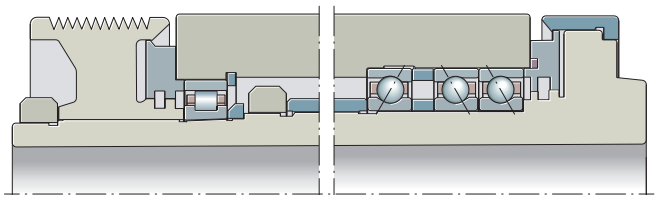
001A87E1

27 Milling spindle for very high speeds



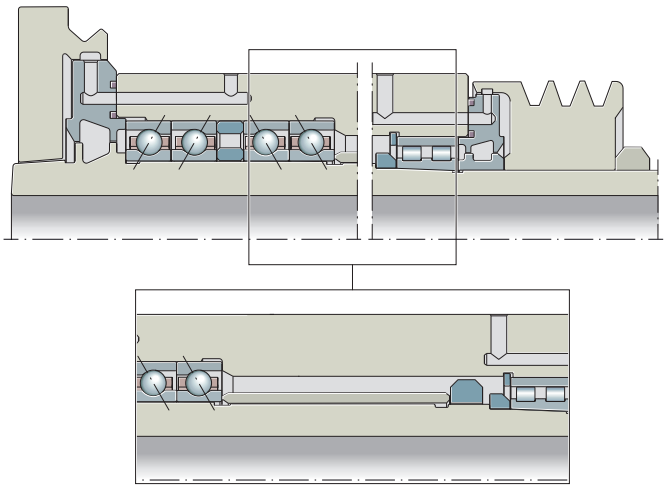
001A87F1

28 Turning spindle



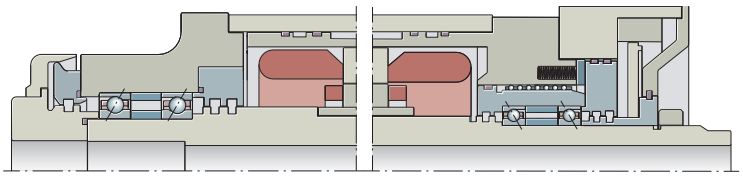
001A87D1

29 Grinding spindle



001A8801

30 High frequency motor spindle



001A8811

## 1.9 Mounting

### 1.9.1 Handling and use

FAG super precision bearings are manufactured in extremely clean conditions, closely inspected and protected by high quality packaging. In order to maintain the full performance capacity of the bearings, they must be handled with great care during mounting. This can best be achieved by the use of a separate, clean room for mounting purposes.

#### 1.9.1.1 Provision of parts

Only approved parts should be used for mounting. Depending on the part, approval comprises dimensional inspection, optical inspection or even prebalancing.

#### 1.9.1.2 Allocation of parts

Fits have a major influence on the function of a bearing arrangement. It is advisable in certain cases to allocate bearings to the spindle diameter or housing diameter. Spindle bearings are subdivided by bore diameter tolerance and outside diameter tolerance into groups whose mean deviation is indicated on the packaging and the bearing.

### 1.9.2 Mounting

#### 1.9.2.1 Guidelines for mounting

The following guidelines must always be taken into account:

- The assembly area must be kept clean and free from dust.
- Protect bearings from dust, contaminants and moisture. Contaminants have a detrimental influence on the running and operating life of rolling bearings.
- Before mounting work is started, familiarise yourself with the design by means of the final assembly drawing.
- Before mounting, check whether the bearing presented for mounting corresponds to the data in the drawing.
- Check the housing bore and shaft seat for dimensional, geometrical and positional accuracy and cleanliness.
- Check that no edges are present which could hamper the mounting of bearing rings on the shaft or in the housing bore. A lead chamfer of 10° to 15° is advantageous in this case.
- Wipe away any anti-corrosion protection from the seating and locating surfaces.

- Rub cylindrical seating surfaces of the bearing rings with a very thin layer of Arcanol MOUNTINGPASTE2.
- Do not cool the bearings excessively. Moisture due to condensation can lead to corrosion in the bearings and bearing seats.
- After mounting, supply the rolling bearings with lubricant.
- Observe the values for axial clamping by means of precision nuts. Use appropriate tools for this purpose. Always tighten the retaining screws of the precision locknuts fully in accordance with the manufacturer's data.
- The covers used for clamping must be matched to the bearings.
- Check the correct functioning of the bearing arrangement.

#### 1.9.2.2 Mounting record

In order to ensure quality, it is recommended that measurement values are recorded, such as:

- seat diameter, interference
- differences in intermediate ring dimensions
- equilibrium temperatures
- radial runout and axial runout

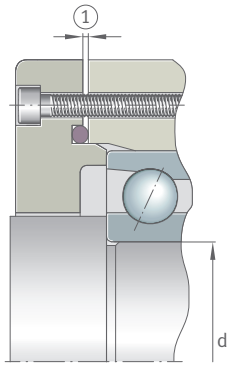
The use of a checklist may be helpful here. The appendix to the catalogue includes a specimen and a template, which are also available to download from the Internet: https://www.schaeffler.de/std/1FC5

#### 1.9.2.3 Matching operations

In order to maintain optimum performance or achieve precise positioning of the spindle in relation to the housing, it is often necessary to carry out special matching operations on the components. This applies, for example, to the end covers used to clamp the bearings. Before clamping, a gap should be present. To simplify and reduce the number of measurement processes, the deviation of the actual width from the nominal width is indicated on the bearing and on the packaging.

Matching of the intermediate rings may be advisable in the case of high speed spindles, in order to compensate the influence of fit and ring expansion on the preload. The deviation of the projection from the nominal projection, as indicated on the bearing and packaging, can be used for this purpose.

31 Matching of end cover (recommendation)




| | | | |
|---|---|---|---|
| d | Bearing bore<br>d ≤100 mm: 0,01 … 0,02 mm<br>Bearing bore<br>d >100 mm: 0,015 … 0,03 mm | 1 | Gap before tightening of the end cover screws |

#### 1.9.2.4 Greasing

Suitable rolling bearing greases and grease quantities, see ➤45|1.6.2. The introduction of the grease quantity places high requirements on the greasing and measurement equipment used. It is recommended that bearings already greased and sealed from Schaeffler are used.

Greasing must be carried out under extremely clean conditions.

In bearings with grease lubrication, a grease distribution cycle must be carried out on the bearings before the test run on the spindle. The recommendations for the grease distribution cycle are available at: http://www.schaeffler.de

#### 1.9.2.5 Axial clamping of inner rings

In order to eliminate or reduce settling effects, the nut should first be tightened to three times the stated torque, loosened and then finally tightened to the nominal torque. The retaining screws should then be fully tightened in accordance with the manufacturer's data.

For spindle bearings B, HS, HC and M of diameter series 719, 70 and 72, the applicable values are in accordance with the table. The stated values correspond to an end face pressure of approx. 10 MPa.

50 Recommended clamping forces and nut tightening torques for spindle bearings

| Bore | Bore code | Clamping force | | | Tightening torque | | | Thread |
|---|---|---|---|---|---|---|---|---|
| mm | | kN | | | Nm | | | |
| | | 719 | 70 | 72 | 719 | 70 | 72 | |
| 10 | 00 | 0,66 | 1,58 | 1,36 | 0,96 | 2,30 | 1,99 | M10×0,75 |
| 12 | 01 | 0,71 | 1,64 | 1,45 | 1,19 | 2,75 | 2,43 | M12×1 |
| 15 | 02 | 0,79 | 1,75 | 1,60 | 1,60 | 3,52 | 3,23 | M15×1 |
| 17 | 03 | 0,86 | 1,84 | 1,73 | 1,93 | 4,11 | 3,87 | M17×1 |
| 20 | 04 | 0,99 | 1,99 | 1,96 | 2,54 | 5,13 | 5,04 | M20×1 |
| 25 | 05 | 1,24 | 2,32 | 2,45 | 3,87 | 7,25 | 7,65 | M25×1,5 |
| 30 | 06 | 1,55 | 2,73 | 3,07 | 5,96 | 10,0 | 11,3 | M30×1,5 |
| 35 | 07 | 1,91 | 3,22 | 3,83 | 8,10 | 13,6 | 16,2 | M35×1,5 |
| 40 | 08 | 2,34 | 3,79 | 4,74 | 11,2 | 18,2 | 22,7 | M40×1,5 |
| 45 | 09 | 2,82 | 4,45 | 5,79 | 15,1 | 23,8 | 31,0 | M45×1,5 |
| 50 | 10 | 3,36 | 5,19 | 7,00 | 19,8 | 30,6 | 41,3 | M50×1,5 |
| 55 | 11 | 3,96 | 6,02 | 8,36 | 25,6 | 38,9 | 54,0 | M55×2 |
| 60 | 12 | 4,62 | 6,94 | 9,88 | 32,4 | 48,6 | 69,3 | M60×2 |
| 65 | 13 | 5,34 | 7,94 | 11,6 | 40,4 | 60,1 | 87,5 | M65×2 |
| 70 | 14 | 6,12 | 9,04 | 13,4 | 49,7 | 73,4 | 109 | M70×2 |
| 75 | 15 | 6,95 | 10,2 | 15,4 | 60,3 | 88,7 | 134 | M75×2 |
| 80 | 16 | 7,85 | 11,5 | 17,6 | 72,4 | 106 | 163 | M80×2 |
| 85 | 17 | 8,81 | 12,9 | 20,0 | 86,2 | 126 | 195 | M85×2 |
| 90 | 18 | 9,82 | 14,3 | 22,5 | 102 | 148 | 233 | M90×2 |
| 95 | 19 | 10,9 | 15,9 | 25,2 | 119 | 173 | 275 | M95×2 |
| 100 | 20 | 12,0 | 17,5 | 28,1 | 138 | 201 | 322 | M100×2 |
| 105 | 21 | 13,2 | 19,3 | 31,2 | 159 | 231 | 374 | M105×2 |
| 110 | 22 | 14,5 | 21,1 | 34,4 | 182 | 265 | 433 | M110×2 |
| 120 | 24 | 17,2 | 25,0 | 41,5 | 235 | 342 | 567 | M120×2 |
| 130 | 26 | 20,1 | 29,4 | 49,3 | 297 | 434 | 729 | M130×2 |
| 140 | 28 | 23,3 | 34,1 | 57,9 | 370 | 541 | 920 | M140×2 |
| 150 | 30 | 26,7 | 39,1 | 67,3 | 454 | 666 | 1144 | M150×2 |
| 160 | 32 | 30,4 | 44,6 | 77,4 | 550 | 808 | 1402 | M160×3 |
| 170 | 34 | 34,3 | 50,5 | 88,4 | 659 | 971 | 1699 | M170×3 |
| 180 | 36 | 38,4 | 56,8 | 100,2 | 781 | 1154 | 2036 | M180×3 |
| 190 | 38 | 42,8 | 63,4 | 112,7 | 918 | 1360 | 2417 | M190×3 |
| 200 | 40 | 47,4 | 70,5 | 126,2 | 1070 | 1589 | 2845 | M200×3 |
| 220 | 44 | 57,5 | 85,8 | 155,5 | 1423 | 2125 | 3853 | Tr220×4 |
| 240 | 48 | 68,4 | 103 | – | 1847 | 2773 | – | Tr240×4 |
| 260 | 52 | 80,4 | – | – | 2349 | – | – | Tr260×4 |
| 280 | 56 | 93,4 | – | – | 2935 | – | – | Tr280×4 |
| 300 | 60 | 107 | – | – | 3612 | – | – | Tr300×4 |

For double direction axial angular contact ball bearings 2344, the applicable values are in accordance with the table.

51 Recommended clamping forces for axial angular contact ball bearings

| Bore | Bore code | Clamping force | | Tightening torque | | Thread |
|---|---|---|---|---|---|---|
| mm | | kN | | Nm | | |
| | | from | up to | from | up to | |
| 30 | 06 | 1,4 | 2,8 | 5,2 | 10,3 | M30×1,5 |
| 35 | 07 | 1,7 | 3,1 | 7,2 | 13,1 | M35×1,5 |
| 40 | 08 | 2,4 | 3,8 | 11,3 | 18,2 | M40×1,5 |
| 45 | 09 | 2,3 | 3,7 | 12,3 | 19,8 | M45×1,5 |
| 50 | 10 | 2,6 | 4,0 | 15,3 | 23,6 | M50×1,5 |
| 55 | 11 | 3,0 | 4,3 | 19,4 | 27,8 | M55×2 |
| 60 | 12 | 3,3 | 4,7 | 23,1 | 32,9 | M60×2 |
| 65 | 13 | 3,7 | 5,1 | 28,0 | 38,6 | M65×2 |
| 70 | 14 | 4,1 | 5,4 | 33,3 | 43,8 | M70×2 |
| 75 | 15 | 4,4 | 5,8 | 38,2 | 50,3 | M75×2 |
| 80 | 16 | 4,8 | 6,2 | 44,3 | 57,2 | M80×2 |
| 85 | 17 | 5,3 | 6,6 | 51,9 | 64,6 | M85×2 |
| 90 | 18 | 5,7 | 7,1 | 58,9 | 73,4 | M90×2 |
| 95 | 19 | 6,1 | 7,5 | 66,5 | 81,7 | M95×2 |
| 100 | 20 | 6,5 | 7,9 | 74,4 | 90,5 | M100×2 |
| 105 | 21 | 7,0 | 8,4 | 84,0 | 101 | M105×2 |
| 110 | 22 | 7,4 | 8,8 | 92,9 | 111 | M110×2 |
| 120 | 24 | 8,4 | 9,8 | 115 | 134 | M120×2 |
| 130 | 26 | 9,3 | 10,8 | 137 | 160 | M130×2 |
| 140 | 28 | 10,3 | 11,8 | 164 | 188 | M140×2 |
| 150 | 30 | 11,3 | 12,8 | 192 | 218 | M150×2 |
| 160 | 32 | 12,4 | 13,8 | 225 | 250 | M160×3 |
| 170 | 34 | 13,4 | 14,9 | 258 | 286 | M170×3 |
| 180 | 36 | 14,5 | 16,0 | 295 | 325 | M180×3 |
| 190 | 38 | 15,7 | 17,2 | 337 | 369 | M190×3 |
| 200 | 40 | 16,8 | 18,3 | 379 | 413 | M200×3 |
| 220 | 44 | 19,2 | 20,7 | 476 | 513 | Tr220×4 |
| 240 | 48 | 21,6 | 23,3 | 583 | 629 | Tr240×4 |
| 260 | 52 | 24,2 | 25,8 | 707 | 754 | Tr260×4 |
| 280 | 56 | 26,8 | 28,4 | 842 | 893 | Tr280×4 |

### 1.9.2.6 Recommendations for shaft nuts

Spindle bearing sets are generally clamped on the shaft using shaft nuts. Nuts with axial holes are to be used in preference over locknuts for tightening on the shaft, since they minimise the air turbulence that occurs at high speeds.

The contact faces of the nuts should be ground in a single clamping operation together with the thread. The recommended maximum axial runout tolerance is 2 µm.

In order to prevent impairment of the runout during the clamping operation, the clamping inserts should be ground together with the thread and the axial face.

### 1.9.2.7 Clearance adjustment of cylindrical roller bearings

Cylindrical roller bearings with a tapered bore are mounted with clearance, clearance-free or with preload. An enveloping circle gauge can assist with setting the clearance to an accuracy of ±1 µm.

## Mounting procedure for cylindrical roller bearings

As an example, a description is given below of the mounting procedure for cylindrical roller bearings with a tapered bore and a separable outer ring, N10 and NN30, and the enveloping circle gauge FAG MGA 31. The FAG gauge can be used to precisely set the radial internal clearance or preload of the cylindrical roller bearings. The user manual must be read before the using the gauge.

- Measure the raceway diameter of the mounted outer ring using a conventional internal gauge.

32 Measuring the raceway diameter of the outer ring




00017047

- Transfer this dimension to the two hardened and precision ground measuring surfaces of the enveloping circle gauge.

33 Transferring the raceway diameter to the enveloping circle gauge




00017048

- Then position the gauge on the inner ring and roller and cage assembly premounted on the tapered shaft.

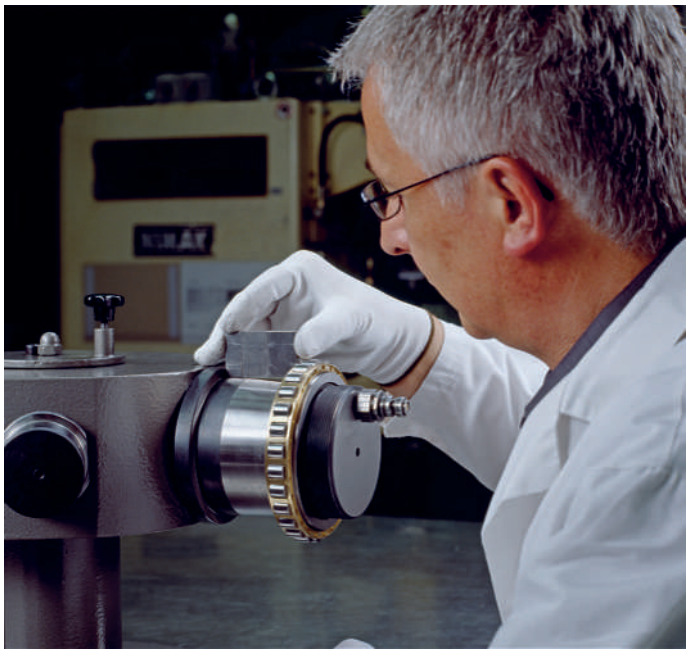
34 Positioning the enveloping circle gauge




00016C6C

- Drive up the bearing axially until the precision indicator of the enveloping circle gauge shows the required radial internal clearance or preload.
- Then determine the spacing between the bearing inner ring and the shaft shoulder using gauge blocks at four measurement points offset by 90°. For larger bearings, the spacing must be measured at a minimum of 6 points.
- After dismounting the bearing inner ring, grind the width of a gauge ring to match the spacing determined and slide this over the cylindrical section of the shaft.
- Finally, mount the bearing inner ring again and secure using a nut. If stated in the drawing, mount the adjacent bearings and secure them by means of a precision locknut.

35 Measuring the spacing from the shaft shoulder



0001704A

## Setting the clearance without a gauge

If an enveloping circle gauge is not available, the clearance can be set to a fairly precise value by measuring the axial drive-up distance of the inner ring on the tapered shaft seat, taper 1:12.

This drive-up distance is approx. 13 to 19 times (drive-up factor F, see table) larger than the radial expansion induced in this way. Surface burnishing and the elastic expansion of the inner ring and the contraction of the shaft are contributory factors here.

11

$$A = F \cdot \Delta G$$

| | | |
|---|---|---|
| A | mm | Drive-up distance |
| F | – | Drive-up factor |
| ΔG | µm | Change in radial clearance |

52 Hollow shaft ratio and drive-up factor

| Hollow shaft ratio $d_B/d'$ | Drive-up factor F |
|---|---|
| 0 ... 0,2 | 13 |
| 0,2 ... 0,3 | 14 |
| 0,3 ... 0,4 | 15 |
| 0,4 ... 0,5 | 16 |
| 0,5 ... 0,6 | 17 |
| 0,6 ... 0,8 | 18 |
| 0,8 ... 0,9 | 19 |

| | | |
|---|---|---|
| $d_B$ | mm | Bore of hollow shaft |
| d’ | mm | Tapered seat diameter, measured at the centre of the taper |

## Calculation of the drive-up distance A

The cylindrical roller bearing is to be clearance-free after mounting.

- Insert the outer ring in the housing bore.
- Mount the inner ring with the spindle in the housing, rotating the spindle back and forth in order to avoid scraping marks.
- Slide the inner ring onto the taper until the radial clearance reaches a value, for example, of 20 µm, rotating the spindle back and forth.

The measurement itself is carried out through radial displacement of the inner ring relative to the outer ring, for example by raising the spindle. The dial gauge should be positioned as close as possible to the bearing for this purpose.

In order to avoid scraping marks in the mounting of cylindrical roller bearings, the following must be observed:

- Do not tilt the inner ring relative to the outer ring.
- Rotate the spindle back in forth while it is being slid into place .

Mounting can be made easier by heating of the housing and outer ring.

- Determine the axial spacing between the inner ring and the locating shoulder, for example by means of gauge blocks at 4 measurement points offset by 90°.
- Grind the gauge ring to width and insert in place.
- Mount the bearing and check for freedom from clearance.

The mounting procedure as described ensures that, after mounting, the bearing has the required radial internal clearance and the position of the bearing inner ring on the shaft is not altered by vibrations during operation.

Calculation of the drive-up distance A:

- drive-up distance A = drive-up factor F · change in radial clearance ΔG
- hollow shaft ratio $d_B/d'$ = 0,55 µm
- drive-up factor F, see table = 17 µm
- change in radial clearance ΔG = 20 µm
- drive-up distance A = 17 · 20 µm = 340 µm = 0,34 mm

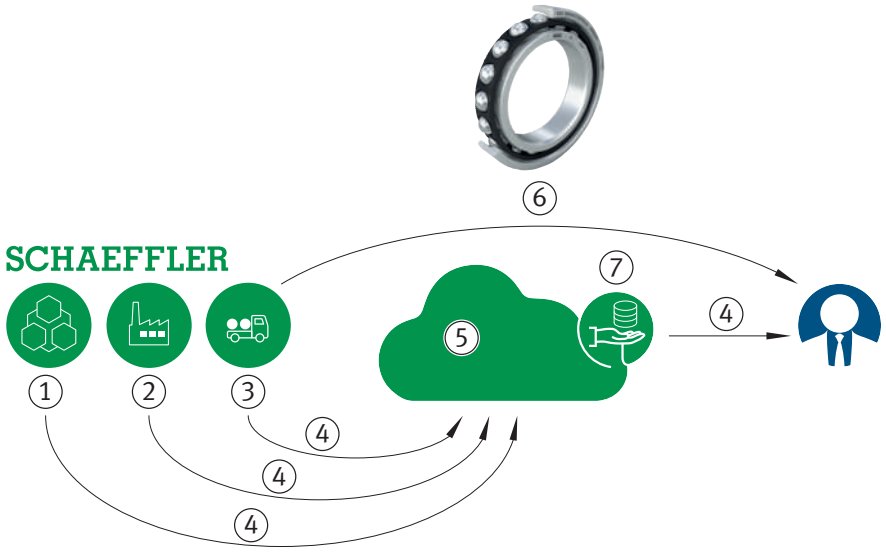
## 1.9.3 Bearing Data Service

### 1.9.3.1 Digitalisation

Digitalisation in the industrial sector is advancing at a rapid rate. The implementation strategies involved are as diverse as our customers and their applications, extending from logistics, assembly, logging and maintenance through to the history of component and systems.

In order to satisfy the respective strategies, Schaeffler provides a powerful and highly scalable technical infrastructure, which allows digital or machine-readable data on rolling bearing products to be processed from various source systems. This technical infrastructure consists of the Schaeffler Data Platform and a standardised interface (Digital Twin Data Service).

36 Technical infrastructure




| | | | |
|---|---|---|---|
| 1 | Engineering | 2 | Production |
| 3 | Logistics | 4 | Data |
| 5 | Digital twin platform | 6 | Product |
| 7 | Data service via API | | |

A data matrix code (DMC) to GS1 standard is used.

37 Data matrix code on rolling bearing




The customer receive access to the rolling bearing product data via the individual serial number contained in the DMC. The rolling bearing product data is highly individual data and actual measurement data from the production processes.

The following individual product data can be made available:

- serial number (SSN)
- bearing designation
- production date
- production plant
- actual value codes (bore diameter, outside diameter)
- actual width deviation
- actual deviation from nominal projection
- actual contact angle

### 1.9.3.2 Generation of added value for customers

The benefit for the customer lies in the automation and acceleration of classic business processes in the value-added chain, as demonstrated by the following examples, which have already been implemented by end customers:

- The automated delivery of measurement values from spindle bearing production to the mounting software of spindle manufacturers and maintenance personnel, for use in the matching process between spindle and bearing. The work involved in manual data transmission is thus eliminated and a one-to-one relationship is created between spindle bearings and spindle on the basis of the data matrix code.
- The use of digitally delivered measurement data on individual bearings, in order to enable prime and highly precise matching of spindle bearing sets and spindles in the customer's inventory management system as early as the provision process.

### 1.9.4 Mounting service

The Schaeffler Mounting Service offers mounting and dismounting services for rolling bearings that are applicable across industrial sectors. The service has detailed knowledge and extensive experience in all industrial sectors.

The experts in the Mounting Service function are trained and skilled personnel who can provide reliable, rapid and competent assistance. The services are provided either at the customer's location or in the Schaeffler workshop facilities.

The mounting services include:

- mounting and dismounting of rolling bearings, plain bearings and bearing systems of all types
- measurement and condition analyses
- problem solving and preparation of concept solutions
- design and manufacture of special tools
- rental of tools
- emergency service
- training courses on products and mounting
- certification of mounting and dismounting processes

The mounting services give the following advantages:

- rapid availability worldwide of experts in bearing arrangement technology with extensive experience in almost every application
- rapid mounting or dismounting by means of professional preparation and implementation
- increased plant availability and productivity as a result of reduced unplanned downtime
- optimisation of mounting and dismounting processes
- professional mounting and dismounting using special high-quality tools
- training and awareness measures for employees relating to the correct handling of bearings of all types

### 1.9.5 Rental of tools

Customers who require special mounting tools or measuring equipment only infrequently can rent these from Schaeffler for a fee.

Our service includes:

- prompt rental in Europe
- free-of-charge, rapid delivery to the installation site
- checked quality products in keeping with the latest technological developments
- delivery of the tools, including all add-on parts
- user manuals available in several languages

If one of our qualified experts in the Mounting Service function is commissioned to carry out the particular activity, rental costs are not generally incurred.

## 1.9.6 Devices for the mounting of super precision bearings

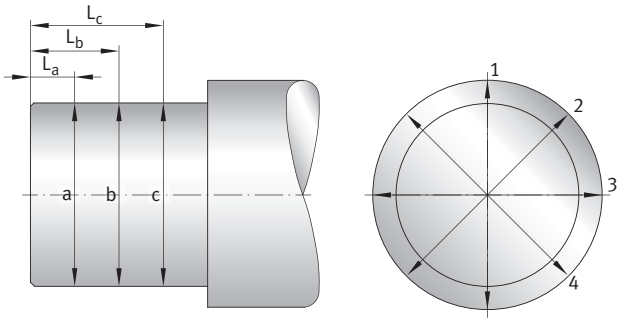
### 1.9.6.1 Devices for measuring the bearing seat

A significant work operation for successful mounting of bearings is the prior measurement of the components used. Various measuring devices are used here. In all measurements, it must be ensured that the measuring device is at approximately the same temperature as the parts to be measured.

#### Cylindrical seating surfaces

The dimensional accuracy of cylindrical seating surfaces and their roundness should be checked with the aid of micrometers at various measurement points.

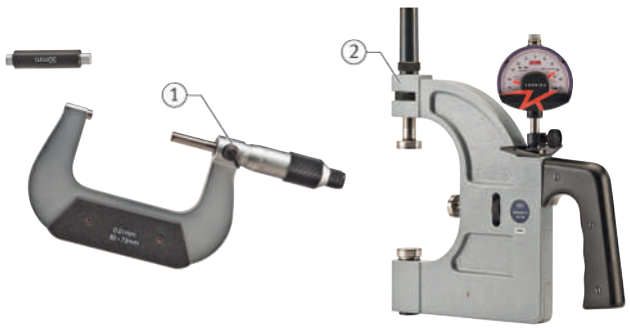
38 Checking the cylindricity of a shaft




00089212

Secure positioning and correct measurement of cylindrical seating surfaces is ensured by the snap gauge. The master disc is marked with the diameter to which the gauge must be set.

39 Gauge for measurement of shaft diameters




0008ACAE

| | | | |
|---|---|---|---|
| 1 | External micrometer | 2 | Snap gauge |

The measurement of bores is carried out using either conventional internal micrometers or so-called comparator gauges. The master ring shown is used for calibration of the measurement tool.

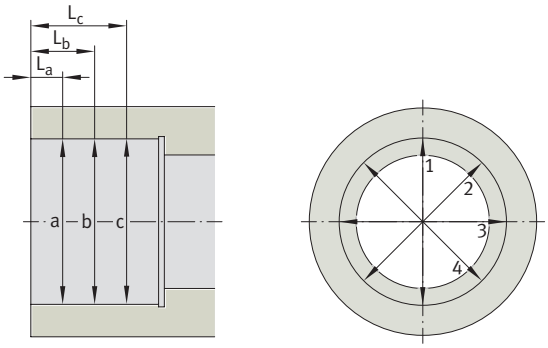
40 Gauge for measurement of bores




0008AD4A

| | | | |
|---|---|---|---|
| 1 | Internal micrometer | 2 | Comparative gauge with master ring |

41 Checking the cylindricity of a housing




00089217

## Tapered seating surfaces

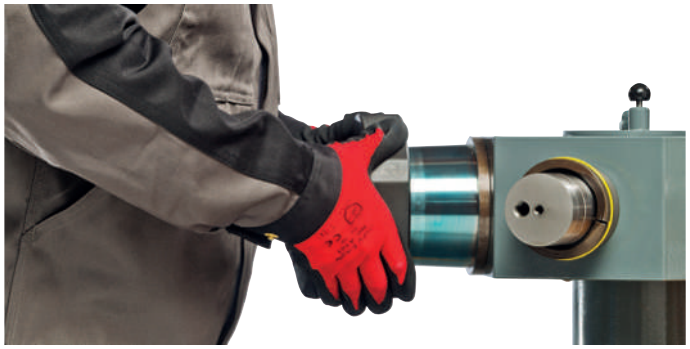
In order to ensure that the inner ring has a tight fit on the shaft, the taper of the shaft must match precisely the taper of the inner ring bore.

The taper of rolling bearing rings is standardised. For most bearing series, it is 1:12. Depending on the requirements and the bearing width, bearings with a taper 1:30 are possible.

The simplest item of measuring equipment for small, tapered bearing seats is the taper ring gauge. By application of inking material, it can be determined whether the shaft and ring gauge match, while corrections are made until the ring gauge is in contact over its whole width.

The inner rings of bearings should not be used as ring gauges.

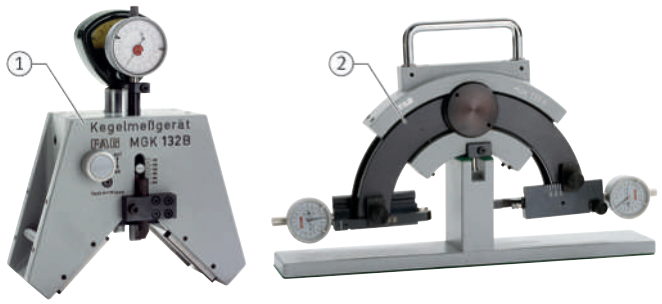
42 Inking with a taper ring gauge



0008AD80

For the precise checking of tapered shaft seating surfaces, Schaeffler has developed the taper gauges FAG MGK 133 and FAG MGK 132. The taper and diameter of the bearing seat are measured precisely using a comparator taper or segment. Both devices are easy to use, since it is not necessary to remove the workpiece from the machining equipment for measurement.

43 Taper gauges




0008AD89

| | | | |
|---|---|---|---|
| 1 | Taper gauge FAG MGK 132 | 2 | Taper gauge FAG MGK 133 |

The taper gauge FAG MGK 133 is used to measure tapers shorter than 80 mm. Depending on the device size, the outside diameter of the taper can measure 27 mm to 205 mm.

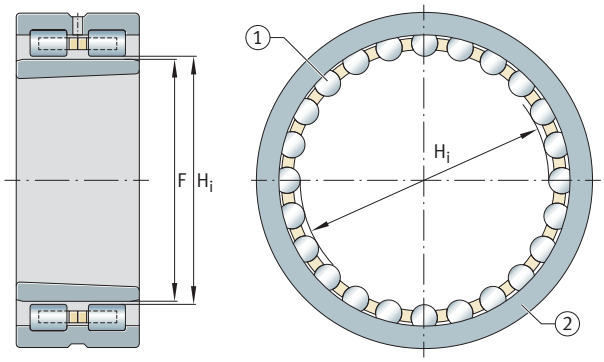
The taper gauge FAG MGK 132 is suitable for taper lengths of 80 mm and above and taper diameters of 90 mm to 820 mm.

## Enveloping circle

The radial internal clearance of a mounted cylindrical roller bearing is determined by the difference between the roller enveloping circle diameter and the raceway diameter of the ribless ring.

In the case of cylindrical roller bearings with a separable inner ring NNU49SK, the radial internal clearance or preload is determined by the difference between the diameter of the inner enveloping circle $H_i$ and the raceway F. The internal enveloping circle is defined as the circle inscribed internally by all rollers when they are in contact with the outer ring raceway.

44 Inner enveloping circle of cylindrical roller bearings NNU49SK




0008B9B6

| | | | |
|---|---|---|---|
| $H_i$ | Inner enveloping circle | F | Raceway diameter |
| 1 | Rolling element | 2 | Outer ring |

The internal enveloping circle is measured using the enveloping circle gauge MGI 21. In conjunction with a snap gauge, the radial internal clearance of the mounted bearing can be determined. The dimension for the enveloping circle diameter is transferred to the snap gauge. The enveloping circle gauge MGI 21 is used for cylindrical roller bearings with a separable inner ring, e.g. NNU49SK.

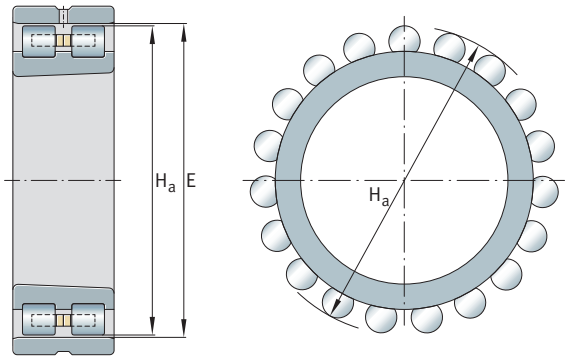
45 Enveloping circle gauge FAG MGI 21




0001831A

In the case of cylindrical roller bearings with a separable outer ring NN30ASK, the radial internal clearance or preload is determined by the difference between the diameter of the raceway E and the external enveloping circle $H_a$. The external enveloping circle is defined as the circle inscribed externally by all rollers when they are in contact with the inner ring raceway.

46 External enveloping circle of cylindrical roller bearings NN30ASK




0008B9A3

| | | | |
|---|---|---|---|
| E | Raceway | $H_a$ | External enveloping circle |

The external enveloping circle is measured using the MGA 31. In conjunction with a bore gauge, the radial internal clearance of the mounted bearing can be determined.

The dimension for the raceway diameter is transferred using the bore gauge to the enveloping circle gauge. The enveloping circle gauge MGA 31 is used for cylindrical roller bearings with a separable inner ring, e.g. FAG NN30ASK.

47 Enveloping circle gauge FAG MGA 31




0001831C

The two opposing steel segments of the enveloping circle gauge are the measuring surfaces. One segment is rigidly attached to the device while the other is capable of radial motion. This motion is transferred to the precision indicator.

For measurement, the bearing outer ring must be mounted in the housing. Once the diameter of the outer ring raceway has been determined using the bore gauge, the dimension is transferred to the enveloping circle gauge.

The inner ring, which is held together with the roller and cage assembly by the cage, is first slid onto the tapered shaft seat with form fit. The enveloping circle gauge is then positioned on the roller and cage assembly and the inner ring is pressed into place until the precision indicator shows the required dimension.

Plus values indicate preload, while minus values indicate radial internal clearance. The value zero gives a clearance-free bearing.

### 1.9.6.2 Induction heating devices

Many rolling bearings and other rotationally symmetrical parts made from steel have tight fits on the shaft. This applies in particular to high speed spindle bearings, since very high interference values must be selected for these in order to prevent the inner rings lifting off under centrifugal force. Rapid and clean induction heating is superior to the conventional methods. It is therefore particularly suitable for batch mounting.

## 1.9.7 Training courses

For the maintenance of main spindles for machine tools, Schaeffler regularly offers a one-day training course on mounting, especially for supervisors and fitters at machine tool operators and manufacturers. Actual implementation is dependent on the number of participants and availability.

The content of this training course covers utilisation of the full performance capacity of FAG super precision bearings, reduction of costs through the use of modern bearing arrangement concepts and the mounting and monitoring of FAG super precision bearings. The training course covers not only new spindle designs but also options for achieving improvements in existing spindles.

The spindle bearing training course is divided into a theoretical section and a practical section.

### 1.9.7.1 Theoretical principles

The following theoretical principles are covered:

- types, designs and performance characteristics of FAG super precision bearings
- tolerances for the adjacent parts and their influence on bearing performance
- lubrication of rolling bearings and rolling bearing failures
- monitoring of bearings in operation
- failure analysis of FAG super precision bearings

### 1.9.7.2 Practical handling

The practical section of the training course covers the following aspects:

- mounting of spindle bearings
- mounting of cylindrical roller bearings with a tapered shaft seat
- use of induction heating devices
- use of special gauges such as enveloping circle gauges and taper gauges

Training courses can also be held on site at the customer's premises upon request.

## 1.9.8 Other products and services

### 1.9.8.1 Further information

For enquires, orders, repairs and recalibrations, please contact Schaeffler Sondermaschinenbau: sondermaschinenbau@schaeffler.com

# 1.10 Bearing monitoring

## 1.10.1 Factors in bearing monitoring

The measurement values to be considered for bearing monitoring are all the factors that respond to changes in the bearing or in the operating conditions. This can include forces, vibrations, temperatures or drive power.

In relation to the monitoring of bearings, however, it should be noted that the absolute values of a measurement parameter are of little significance in themselves. Greater importance should be attached to the occurrence of any changes. For example, a constant temperature of +40 °C is not detrimental to a rolling bearing. However, an increase in the temperature over a short period from +35 °C to +40 °C may well be an early indication of bearing damage.

## 1.10.2 Types of monitoring

### 1.10.2.1 Periodic monitoring

When selecting a suitable monitoring method, it must be noted that continuous progress in damage over an extended period can only be expected at low and moderate speeds. In such cases, periodic monitoring may be appropriate.

### 1.10.2.2 Continuous monitoring

In the range of high to very high speeds, abrupt failure must be included in the risk assessment, which means that continuous monitoring is the only method that should be used in order to limit damage.

### 1.10.2.3 One-off monitoring

One-off monitoring is only used for quality assurance in the case of newly manufactured or repaired spindles. For example, measurement of run-down time or natural frequency measurement can be considered for these purposes. These methods can be used for the rapid and reliable detection of preload errors.

Temperature measurement and the measurement of vibration velocities and accelerations are also methods commonly used for quality assurance. As is the case with measurement of run-down time, however, these can only be used as comparative methods.

### 1.10.2.4 Temperature monitoring

In many cases, temperature is highly significant as an indicator of the operating behaviour of a bearing. In the case of bearings with grease lubrication, it can generally be used to detect damage or forthcoming failure in good time.

Where changes in preload or malfunction of non-locating bearings occur, there are relatively stable specimens of typical temperature curves.

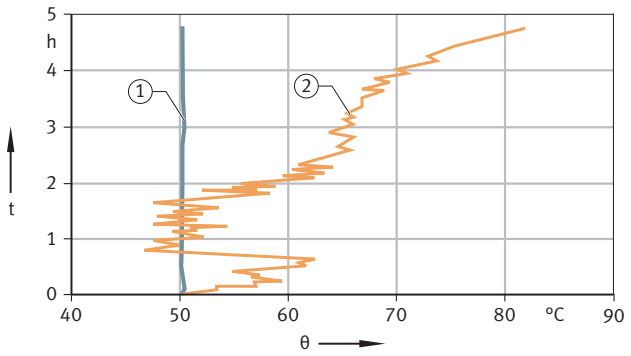
The temperature is generally measured on the stationary ring. This is normally the outer ring. Assessment is generally based on the change in temperature over time.

In order to achieve reliable temperature measurement, the following rules must be observed:

- Carry out measurement as close as possible to the bearing.
- Carry out measurement as continuously as possible.
- Prevent bearing deformation by means of measurement sensors.

A bearing will normally show a stable temperature behaviour. Towards the end of the grease operating life, however, the temperature will fluctuate. Intervention is necessary at the latest when a progressive pattern becomes apparent.

48 Bearing/temperature behaviour




| | | | |
|---|---|---|---|
| t | Time | θ | Temperature |
| 1 | Normal | 2 | End of grease operating life |

# 2 Spindle bearings

## 2.1 Features

FAG spindle bearings are super precision, single row angular contact ball bearings with solid outer and inner rings, ball and cage assemblies and solid window cages. The dimensions are standardised.

Due to their very narrow tolerances, the spindle bearings are particularly suitable for applications involving the highest requirements for guidance accuracy, such as bearing arrangements for main spindles in machine tools.

### 2.1.1 Extensive range of product variants

The bearings are available in all the designs that are relevant to bearing arrangements for main spindles in machine tools. This extensive range of variants is presented in the product tables. In addition to the products listed therein, further designs are available by agreement.

This extensive product range gives the designer all possible scope for developing technically innovative, operationally secure and economical bearing arrangements. This results in significant performance improvements and cost savings in machine tools.

In new designs, this can allow the machine manufacturer to achieve a unique position in the market. In existing designs too, refitting with FAG spindle bearings can still give further increases in the performance and profitability of machines.

49 FAG spindle bearings



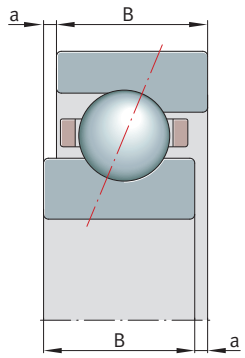
001A4C76

### 2.1.2 Universal bearings

FAG spindle bearings are always designed as universal bearings, which means that:

- The bearing rings are of the same width.
- The projection on both sides of the bearing is of the same size.

50 Universal preload system




| | | | |
|---|---|---|---|
| B | Bearing width | a | Projection |

Single bearings can be fitted in any arrangement required, such as a rigid X, O or tandem arrangement or with spring preloading, or can be combined in different sets.

In order to ensure uniform load-bearing in the tandem arrangement, the bearings used should have the same deviation in the inner ring bore and the outside diameter.

In an O arrangement and with rigid adjustment, sorting through checking of the interference between the shaft and bearing bore or between the housing bore and bearing outside diameter can help to control the differences in the actual preload after mounting.

Arrangement of the bearings can be carried out in accordance with the arrow on the cylindrical surface of the outer ring. This provides logistical advantages for the customer, especially in spare parts procurement and stockholding of bearings.

### 2.1.3 Universal bearing sets

Bearing sets comprise universal bearings with the same deviation in the inner ring bore and the same deviation in the outside diameter.

The deviation stands as the actual value code for the inner ring bore or the outside diameter on the bearing ring.

The sets are of identical technical quality to single bearings with the same deviation in the inner ring bore and the outside diameter.

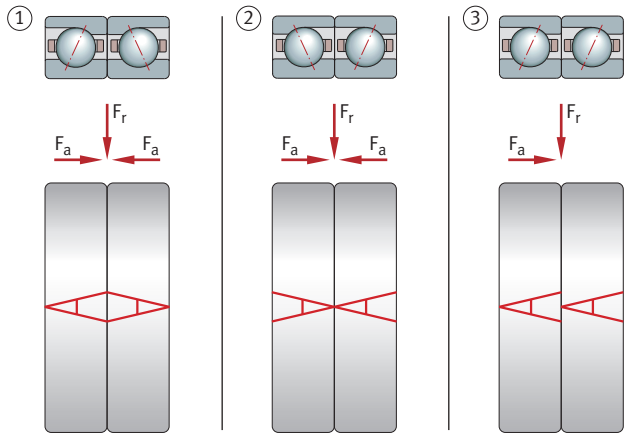
The first letter indicates the number of bearings in the set:

- D = 2 bearings (duplex)
- T = 3 bearings (triplex)
- Q = 4 bearings (quadruplex)

A U stands for “Universal”, for example in DU. After these letters, the preload class is then indicated, for example L for light preload, in this case DUL.

Universal bearing sets can be mounted in any arrangement required.

51 Bearing arrangements of a DU set




| $F_r$ | Radial load | $F_a$ | Axial load |
|---|---|---|---|
| 1 | DU becomes DB, 2 bearing set in O arrangement | 2 | DU becomes DF, 2 bearing set in X arrangement |
| 3 | DU becomes DT, 2 bearing set in tandem arrangement | | |

Ready-to-fit bearing sets are also available by agreement. In this case, the fitting sequence is indicated by a large arrow.

Ready-to-fit bearing sets correspond in technical terms to the universal bearing sets. Universal bearing sets, however, offer significant logistical advantages over the ready-to-fit sets, especially in the procurement and stockholding of spare parts.

### 2.1.4 Load carrying capacity and contact angle

Universal bearings can support axial loads in one direction as well as radial loads.

If bearings are used in an O or X arrangement, they can support axial forces in both directions as well as moments. Bearings in a tandem arrangement can only support axial loads in one direction.

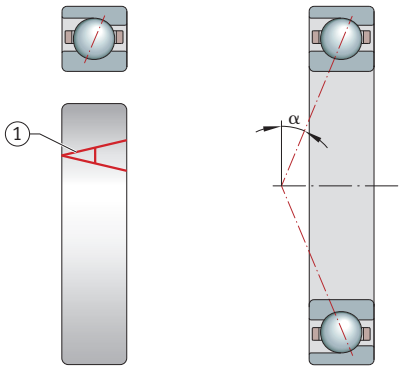
The contact angle indicates the axial load carrying capacity of the bearing. As the contact angle increases, so does the axial load carrying capacity.

FAG spindle bearings are available with the contact angle:

- α = 15 (suffix C )
- α = 17 (suffix C, M series)
- α = 25 (suffix E )

The load direction of the outer ring is marked on the cylindrical surface of the outer ring. The open side of the symbol indicates the side of the outer ring capable of supporting axial load (the large shoulder).

52 Symbol indicating the load direction of the outer ring




00095922

| | | | |
|---|---|---|---|
| α | Contact angle | 1 | Marking |

### 2.1.5 Bearing types and product characteristics

Universal spindle bearings are available in B, M and H bearing designs.

B spindle bearings:

- classical spindle bearing
- with large balls
- contact angle 15° and 25°
- very high load carrying capacity and high rigidity
- for moderate speed level

M spindle bearing in X-life design:

- with medium balls
- contact angle 17° and 25°
- suitable for high to very high speeds due to bearing internal design with optimised friction
- kinematic insensitivity to tilting
- high load carrying capacity
- particularly suitable for high speed milling spindles and motor spindles.

H spindle bearings(high speed design):

- with small balls
- contact angle 15° and 25°
- suitable for very high speeds due to internal design with optimised friction and very low centrifugal forces on the rolling elements
- high rigidity at high speeds
- particularly suitable for very high speed spindles and grinding spindles

The bearings are available with steel and ceramic balls and in an open, sealed and Direct Lube design.

M spindle bearings in X-life design are also available with rings made from the high performance steel Vacrodur in conjunction with ceramic balls.

### 2.1.6 Hybrid bearings

Hybrid spindle bearings have bearing rings made from steel and, in contrast to standard spindle bearings, rolling elements made from ceramic (silicon nitride $Si_3N_4$).

53 Hybrid spindle bearings




| | | | |
|---|---|---|---|
| 1 | Ceramic rolling element | 2 | Direct Lube design with circumferential annular grooves |

Hybrid spindle bearings achieve very high speeds, have lower friction and heat generation, a longer operating life, place less strain on the lubricant and are insensitive to lubricant starvation.

Through the use of hybrid bearings, the operating limits of bearings with grease lubrication have been shifted to significantly higher speed ranges. This results in considerable savings on overall machine system costs.

### 2.1.7 Bearing rings made from Vacrodur

Bearings with rings made from Vacrodur are suitable for very high speeds and have very high load carrying capacity. These bearings are always designed as hybrid bearings. Vacrodur is a high performance steel with an exceptionally homogeneous and fine structure.

Vacrodur has, in comparison with the normal rolling bearing steel 100Cr6, a significantly higher hardness above 65 HRC combined with simultaneously high toughness. As a result, the permissible contact pressure is higher.

In the event of lubricant contamination, the high hardness and toughness of the material leads to a reduction in initial damage caused by overrolling of foreign particles. In the mixed friction range, rating life values of up to 25 times the normal value have even been achieved.

It is also significantly superior to conventional rolling bearing steels where high temperature hardness is concerned.

The longer life achieved with Vacrodur compared to conventional rolling bearing steel makes a considerable contribution to reducing system costs.

### 2.1.8 Open and sealed spindle bearings

Spindle bearings are super precision machine elements that react with high sensitivity to harmful influences from the environment such as the ingress of contamination or air streams.

In sealed designs, the rolling element system is protected by gap seals on both sides of the bearings.

Due to their particular advantages, these non-contact seals have long been the state of the art for sealed main spindle bearings.

Sealed bearings with small balls have the letter S (Sealed) in the designation. Spindle bearings with large and medium balls have the suffix 2RSD.

54 Sealed spindle bearings




| | |
|---|---|
| 1 | Gap seal |

Since the grease operating life can generally be equated to the bearing operating life, machine life values are also directly influenced by the correct grease quantity and selection of the lubricant. Sealed bearings are therefore supplied already greased with the correct quantity of a high performance grease.

Furthermore, the increase in the use of sealed bearings reflects the change from oil lubrication to economical grease lubrication with ready-to-fit, maintenance-free bearings with lifetime lubrication.

When selecting a lubricant, the operating temperature of the lubricant must be taken into consideration.

### 2.1.9 Direct Lube design

These bearings are designed for extremely high speeds. They are used where pneumatic oil lubrication is necessary and a reliable supply of lubricant must be ensured. They are thus an ideal addition to the spindle bearing range.

Direct Lube bearings provide reliable feed of lubricant directly to the contact point. This is achieved by means of circumferential annular grooves and radial feed holes.

The bearing is sealed off from the spindle housing by means of integrated high precision O-rings.

In addition, the adjacent construction can be simplified since the bearing design means that it no longer has to include certain expensive elements. This reduces both the design envelope and the costs.

55 Bearing in Direct Lube design




001ACE97

| | | | |
|---|---|---|---|
| 1 | Ceramic rolling element | 2 | Direct Lube design with circumferential annular grooves |

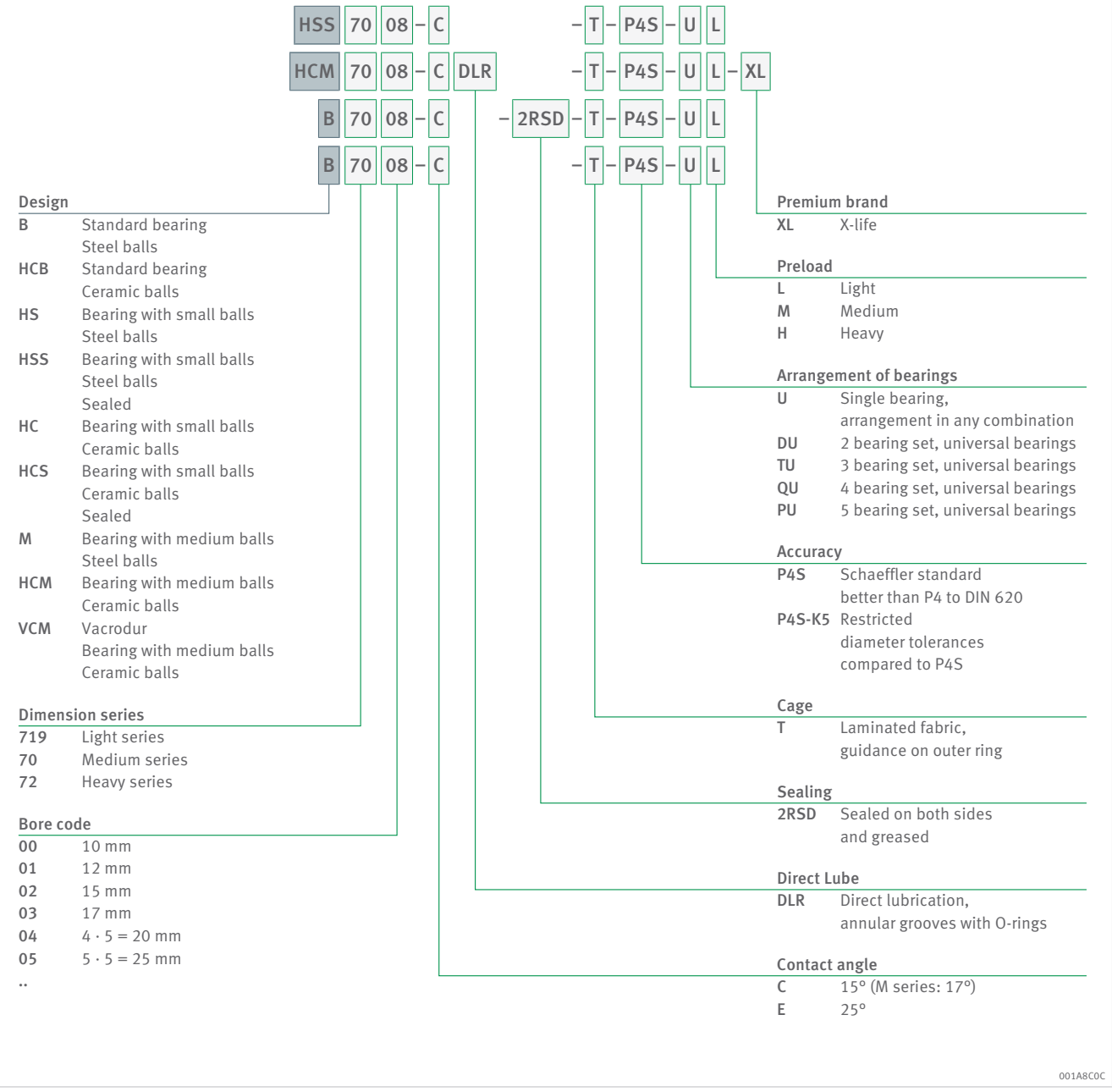
### 2.1.10 Cages

Spindle bearings have solid window cages made from laminated fabric (suffix T). The cage is guided on the outer ring.

Check the chemical resistance of the seal material and cage material when using synthetic greases and lubricants with EP additives. Additives in the oil can impair the operating life of the cages at high temperatures.

## 2.1.11 Designation and marking of bearings

56 Bearing designation



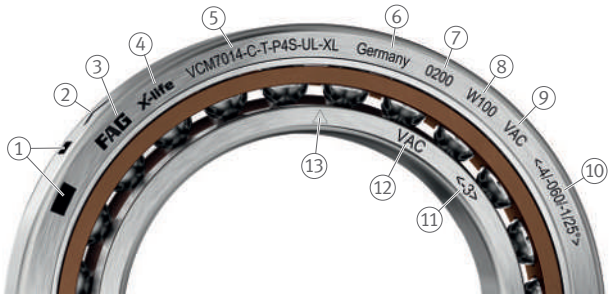
FAG spindle bearings for machine tools have a uniform designation system.

In addition to the actual bearing designation, this also contains information on the:

- tolerances and actual value codes (bore, outside diameter, width, projection, contact angle)
- mounting position indicated by the marking on the cylindrical surface of the outer ring (symbol indicating the load direction of the outer ring)

These indications are, depending on the size of the bearing, subject to tolerances. The marking is located on the end faces of the bearing rings.

57 Example of marking for bearing with Vacrodur rings




| | | | |
|---|---|---|---|
| 1 | Data matrix code | 2 | Symbol indicating the load direction of the outer ring |
| 3 | Trademark | 4 | X-life premium brand |
| 5 | Short designation | 6 | Country of manufacture |
| 7 | Internal code | 8 | Internal code |
| 9 | Special material for outer ring | 10 | Actual value code for outside diameter/ actual deviation of width in µm/actual deviation from nominal projection in µm/actual contact angle |
| 11 | Actual value code for the bore | 12 | Special material for the inner ring |
| 13 | Symbol for the largest wall thickness of the inner ring | | |

58 Example of marking for sealed spindle bearings




| | | | |
|---|---|---|---|
| 1 | Data matrix code | 2 | Symbol indicating the load direction of the outer ring |
| 3 | Trademark | 4 | Short designation |
| 5 | Country of manufacture | 6 | Internal code |
| 7 | Internal code | 8 | Actual value code for bore/actual value code for outside diameter/actual deviation of width in µm/actual deviation from nominal projection in µm/actual contact angle |

## 2.2 Product tables

### 2.2.1 Explanations

| | | |
|---|---|---|
| B | mm | Width |
| $B_N$ | mm | Ring groove spacing |
| $C_{0r}$ | N | Basic static load rating, radial |
| $c_a$ H | N/µm | Axial rigidity, high |
| $c_a$ L | N/µm | Axial rigidity, slight |
| $c_a$ M | N/µm | Axial rigidity, moderate |
| $C_r$ | N | Basic dynamic load rating, radial |
| d | mm | Bore diameter |
| D | mm | Outside diameter |
| $d_a$ | mm | Abutment diameter, shaft shoulder |
| $D_a$ | mm | Abutment diameter, outer ring |
| $E_{tk}$ | mm | Injection pitch circle diameter |
| $E_{tk1}$ | mm | Injection pitch circle diameter 1 |
| $F_V$ H | N | Preload force, high |
| $F_V$ L | N | Preload force, slight |
| $F_V$ M | N | Preload force, moderate |
| $K_{aE}$ H | N | Lift-off force, high |
| $K_{aE}$ L | N | Lift-off force, slight |
| $K_{aE}$ M | N | Lift-off force, moderate |
| m | kg | Mass |
| $n_G$ | $min^{-1}$ | Limiting speed |
| $n_G$ grease | $min^{-1}$ | Limiting speed for grease lubrication |
| $n_G$ oil | $min^{-1}$ | Limiting speed for oil lubrication |
| $r_{1\ min}$ | mm | Min. chamfer dimension |
| $r_{a\ max}$ | mm | Max. undercut radius |
| $r_{a1\ max}$ | mm | Max. undercut radius |
| $r_{min}$ | mm | Min. chamfer dimension |
| $S_B$ | mm | Lubrication groove width |
| $S_N$ | mm | Lubrication hole spacing |
| α | ° | Contact angle |

## 2.2.2 Spindle bearings

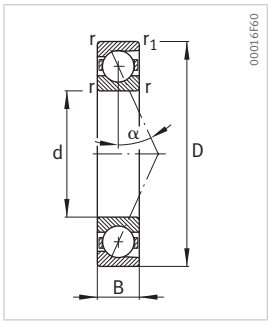
With large, medium or small balls

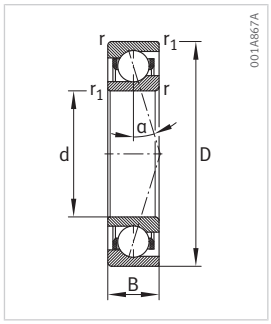
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

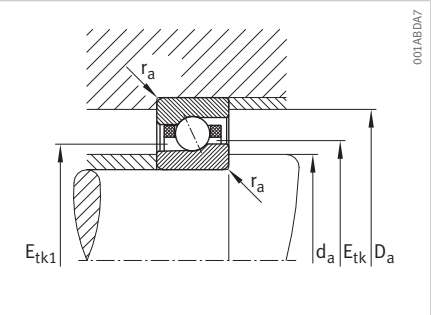
sealed



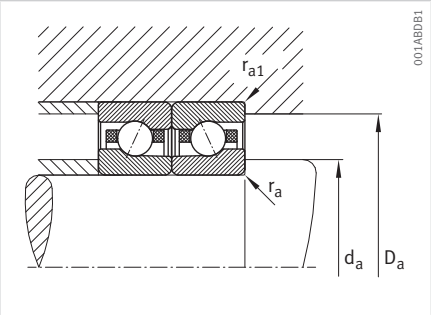




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B71900-C-T-P4S** | • | 0,01 | 10 | 22 | 6 | 0,3 | 0,3 | 15 | 13 | 19,5 | 0,3 | 0,1 |
| **B71900-E-T-P4S** | • | 0,01 | 10 | 22 | 6 | 0,3 | 0,3 | 25 | 13 | 19,5 | 0,3 | 0,1 |
| **HCB71900-C-T-P4S** | • | 0,009 | 10 | 22 | 6 | 0,3 | 0,3 | 15 | 13 | 19,5 | 0,3 | 0,1 |
| **HCB71900-E-T-P4S** | • | 0,009 | 10 | 22 | 6 | 0,3 | 0,3 | 25 | 13 | 19,5 | 0,3 | 0,1 |
| **HS71900-C-T-P4S** | • | 0,01 | 10 | 22 | 6 | 0,3 | 0,3 | 15 | 13 | 19,5 | 0,3 | 0,1 |
| **HS71900-E-T-P4S** | • | 0,01 | 10 | 22 | 6 | 0,3 | 0,3 | 25 | 13 | 19,5 | 0,3 | 0,1 |
| **HC71900-E-T-P4S** | • | 0,01 | 10 | 22 | 6 | 0,3 | 0,3 | 25 | 13 | 19,5 | 0,3 | 0,1 |
| **B7000-C-T-P4S** | • | 0,02 | 10 | 26 | 8 | 0,3 | 0,3 | 15 | 14 | 22 | 0,3 | 0,1 |
| **B7000-E-T-P4S** | • | 0,02 | 10 | 26 | 8 | 0,3 | 0,3 | 25 | 14 | 22 | 0,3 | 0,1 |
| **HCB7000-C-T-P4S** | • | 0,018 | 10 | 26 | 8 | 0,3 | 0,3 | 15 | 14 | 22 | 0,3 | 0,1 |
| **HCB7000-E-T-P4S** | • | 0,018 | 10 | 26 | 8 | 0,3 | 0,3 | 25 | 14 | 22 | 0,3 | 0,1 |
| **HS7000-C-T-P4S** | • | 0,021 | 10 | 26 | 8 | 0,3 | 0,3 | 15 | 14 | 22 | 0,3 | 0,1 |
| **HS7000-E-T-P4S** | • | 0,021 | 10 | 26 | 8 | 0,3 | 0,3 | 25 | 14 | 22 | 0,3 | 0,1 |
| **HC7000-E-T-P4S** | • | 0,021 | 10 | 26 | 8 | 0,3 | 0,3 | 25 | 14 | 22 | 0,3 | 0,1 |
| **B7200-C-T-P4S** | • | 0,032 | 10 | 30 | 9 | 0,6 | 0,6 | 15 | 14,5 | 25,5 | 0,6 | 0,3 |
| **B7200-E-T-P4S** | • | 0,032 | 10 | 30 | 9 | 0,6 | 0,6 | 25 | 14,5 | 25,5 | 0,6 | 0,3 |
| **HCB7200-C-T-P4S** | • | 0,029 | 10 | 30 | 9 | 0,6 | 0,6 | 15 | 14,5 | 25,5 | 0,6 | 0,3 |
| **HCB7200-E-T-P4S** | • | 0,029 | 10 | 30 | 9 | 0,6 | 0,6 | 25 | 14,5 | 25,5 | 0,6 | 0,3 |
| **B71901-C-T-P4S** | • | 0,011 | 12 | 24 | 6 | 0,3 | 0,3 | 15 | 15 | 21,5 | 0,3 | 0,1 |
| **B71901-E-T-P4S** | • | 0,011 | 12 | 24 | 6 | 0,3 | 0,3 | 25 | 15 | 21,5 | 0,3 | 0,1 |
| **HCB71901-C-T-P4S** | • | 0,01 | 12 | 24 | 6 | 0,3 | 0,3 | 15 | 15 | 21,5 | 0,3 | 0,1 |
| **HCB71901-E-T-P4S** | • | 0,01 | 12 | 24 | 6 | 0,3 | 0,3 | 25 | 15 | 21,5 | 0,3 | 0,1 |
| **HS71901-C-T-P4S** | • | 0,011 | 12 | 24 | 6 | 0,3 | 0,3 | 15 | 15 | 21,5 | 0,3 | 0,1 |
| **HS71901-E-T-P4S** | • | 0,011 | 12 | 24 | 6 | 0,3 | 0,3 | 25 | 15 | 21,5 | 0,3 | 0,1 |
| **HC71901-E-T-P4S** | • | 0,011 | 12 | 24 | 6 | 0,3 | 0,3 | 25 | 15 | 21,5 | 0,3 | 0,1 |
| **B7001-C-T-P4S** | • | 0,023 | 12 | 28 | 8 | 0,3 | 0,3 | 15 | 16,5 | 24,5 | 0,3 | 0,1 |
| **B7001-E-T-P4S** | • | 0,023 | 12 | 28 | 8 | 0,3 | 0,3 | 25 | 16,5 | 24,5 | 0,3 | 0,1 |
| **HCB7001-C-T-P4S** | • | 0,02 | 12 | 28 | 8 | 0,3 | 0,3 | 15 | 16,5 | 24,5 | 0,3 | 0,1 |
| **HCB7001-E-T-P4S** | • | 0,02 | 12 | 28 | 8 | 0,3 | 0,3 | 25 | 16,5 | 24,5 | 0,3 | 0,1 |
| **HS7001-C-T-P4S** | • | 0,024 | 12 | 28 | 8 | 0,3 | 0,3 | 15 | 16,5 | 24,5 | 0,3 | 0,1 |
| **HS7001-E-T-P4S** | • | 0,024 | 12 | 28 | 8 | 0,3 | 0,3 | 25 | 16,5 | 24,5 | 0,3 | 0,1 |
| **HC7001-E-T-P4S** | • | 0,023 | 12 | 28 | 8 | 0,3 | 0,3 | 25 | 16,5 | 24,5 | 0,3 | 0,1 |
| **B7201-C-T-P4S** | • | 0,037 | 12 | 32 | 10 | 0,6 | 0,6 | 15 | 16,5 | 27,5 | 0,6 | 0,3 |
| **B7201-E-T-P4S** | • | 0,037 | 12 | 32 | 10 | 0,6 | 0,6 | 25 | 16,5 | 27,5 | 0,6 | 0,3 |
| **HCB7201-C-T-P4S** | • | 0,032 | 12 | 32 | 10 | 0,6 | 0,6 | 15 | 16,5 | 27,5 | 0,6 | 0,3 |
| **HCB7201-E-T-P4S** | • | 0,032 | 12 | 32 | 10 | 0,6 | 0,6 | 25 | 16,5 | 27,5 | 0,6 | 0,3 |
| **B71902-C-T-P4S** | • | 0,016 | 15 | 28 | 7 | 0,3 | 0,3 | 15 | 18 | 25,5 | 0,3 | 0,1 |
| **B71902-E-T-P4S** | • | 0,016 | 15 | 28 | 7 | 0,3 | 0,3 | 25 | 18 | 25,5 | 0,3 | 0,1 |
| **HCB71902-C-T-P4S** | • | 0,014 | 15 | 28 | 7 | 0,3 | 0,3 | 15 | 18 | 25,5 | 0,3 | 0,1 |
| **HCB71902-E-T-P4S** | • | 0,014 | 15 | 28 | 7 | 0,3 | 0,3 | 25 | 18 | 25,5 | 0,3 | 0,1 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 14,4 | 14,4 | 15 | 15 | 3000 | 1070 | 75000 | 120000 | 10 | 41 | 87 | 31 | 141 | 320 | 11 | 21 | 31 |
| 14,4 | 14,4 | 15 | 15 | 2900 | 1020 | 70000 | 110000 | 17 | 74 | 163 | 50 | 226 | 521 | 27 | 48 | 67 |
| 14,4 | 14,4 | 15 | 15 | 3000 | 1020 | 110000 | 160000 | 6 | 25 | 54 | 17 | 79 | 185 | 10 | 18 | 27 |
| 14,4 | 14,4 | 15 | 15 | 2900 | 980 | 95000 | 150000 | 5 | 35 | 85 | 16 | 104 | 260 | 20 | 40 | 57 |
| 14,6 | 13,7 | 15 | 15 | 1790 | 650 | 100000 | 160000 | 7 | 20 | 39 | 20 | 63 | 132 | 9 | 14 | 20 |
| 14,6 | 13,7 | 15 | 15 | 1700 | 620 | 95000 | 140000 | 11 | 32 | 64 | 31 | 96 | 196 | 22 | 33 | 43 |
| 14,6 | 13,7 | 15 | 15 | 1700 | 600 | 120000 | 180000 | 7 | 22 | 45 | 21 | 65 | 133 | 22 | 32 | 42 |
| 15,7 | 15,7 | 16,8 | 16,8 | 4100 | 1470 | 67000 | 100000 | 18 | 65 | 136 | 54 | 220 | 490 | 13 | 23 | 34 |
| 15,7 | 15,7 | 16,8 | 16,8 | 3950 | 1410 | 60000 | 95000 | 21 | 99 | 223 | 61 | 298 | 698 | 28 | 49 | 69 |
| 15,7 | 15,7 | 16,8 | 16,8 | 4150 | 1400 | 95000 | 140000 | 7 | 33 | 74 | 21 | 104 | 248 | 10 | 19 | 27 |
| 15,7 | 15,7 | 16,8 | 16,8 | 3950 | 1350 | 85000 | 130000 | 12 | 57 | 130 | 33 | 167 | 392 | 25 | 45 | 62 |
| 16,4 | 15,3 | 16,9 | 16,9 | 2470 | 940 | 90000 | 140000 | 9 | 28 | 55 | 28 | 89 | 185 | 11 | 17 | 24 |
| 16,4 | 15,3 | 16,9 | 16,9 | 2350 | 890 | 85000 | 130000 | 15 | 45 | 90 | 43 | 133 | 273 | 27 | 40 | 53 |
| 16,4 | 15,3 | 16,9 | 16,9 | 2360 | 860 | 110000 | 160000 | 10 | 31 | 62 | 30 | 91 | 185 | 27 | 40 | 51 |
| 18 | 18 | 19,2 | 19,2 | 6900 | 2950 | 56000 | 85000 | 25 | 91 | 185 | 79 | 311 | 684 | 16 | 30 | 44 |
| 18 | 18 | 19,2 | 19,2 | 6600 | 2800 | 50000 | 75000 | 32 | 141 | 314 | 94 | 429 | 995 | 36 | 63 | 89 |
| 18 | 18 | 19,2 | 19,2 | 7000 | 2800 | 67000 | 100000 | 11 | 47 | 103 | 32 | 150 | 352 | 13 | 24 | 35 |
| 18 | 18 | 19,2 | 19,2 | 6600 | 2700 | 60000 | 90000 | 18 | 82 | 185 | 52 | 243 | 564 | 33 | 57 | 79 |
| 16,4 | 16,4 | 17,2 | 17,2 | 3400 | 1310 | 67000 | 100000 | 11 | 46 | 97 | 34 | 155 | 355 | 13 | 24 | 36 |
| 16,4 | 16,4 | 17,2 | 17,2 | 3250 | 1250 | 60000 | 95000 | 18 | 80 | 179 | 53 | 245 | 567 | 31 | 54 | 77 |
| 16,4 | 16,4 | 17,2 | 17,2 | 3400 | 1250 | 95000 | 140000 | 6 | 27 | 60 | 18 | 87 | 205 | 11 | 21 | 30 |
| 16,4 | 16,4 | 17,2 | 17,2 | 3250 | 1190 | 85000 | 130000 | 5 | 38 | 92 | 16 | 111 | 281 | 23 | 46 | 65 |
| 16,6 | 15,7 | 17 | 17 | 1850 | 720 | 90000 | 140000 | 7 | 21 | 41 | 21 | 66 | 137 | 9 | 15 | 21 |
| 16,6 | 15,7 | 17 | 17 | 1760 | 690 | 85000 | 130000 | 11 | 33 | 67 | 32 | 99 | 203 | 23 | 35 | 46 |
| 16,6 | 15,7 | 17 | 17 | 1760 | 660 | 110000 | 160000 | 8 | 23 | 46 | 22 | 68 | 138 | 23 | 34 | 44 |
| 17,9 | 17,9 | 18,8 | 18,8 | 4650 | 1830 | 60000 | 90000 | 19 | 73 | 152 | 59 | 242 | 543 | 15 | 27 | 39 |
| 17,9 | 17,9 | 18,8 | 18,8 | 4450 | 1750 | 53000 | 85000 | 23 | 109 | 248 | 66 | 328 | 775 | 32 | 57 | 80 |
| 17,9 | 17,9 | 18,8 | 18,8 | 4700 | 1750 | 85000 | 130000 | 8 | 36 | 82 | 22 | 114 | 274 | 11 | 21 | 31 |
| 17,9 | 17,9 | 18,8 | 18,8 | 4450 | 1670 | 75000 | 120000 | 12 | 63 | 145 | 35 | 184 | 436 | 29 | 52 | 72 |
| 18,4 | 17,3 | 18,9 | 18,9 | 2450 | 960 | 80000 | 130000 | 9 | 27 | 54 | 27 | 87 | 181 | 11 | 17 | 24 |
| 18,4 | 17,3 | 18,9 | 18,9 | 2320 | 910 | 75000 | 110000 | 15 | 44 | 88 | 43 | 131 | 268 | 27 | 40 | 53 |
| 18,4 | 17,3 | 18,9 | 18,9 | 2330 | 870 | 95000 | 140000 | 10 | 30 | 61 | 29 | 89 | 181 | 26 | 39 | 51 |
| 19,6 | 19,6 | 21,1 | 21,1 | 9100 | 3900 | 50000 | 75000 | 35 | 123 | 248 | 109 | 420 | 916 | 19 | 35 | 50 |
| 19,6 | 19,6 | 21,1 | 21,1 | 8800 | 3750 | 45000 | 67000 | 47 | 193 | 423 | 137 | 588 | 1342 | 43 | 74 | 103 |
| 19,6 | 19,6 | 21,1 | 21,1 | 9100 | 3700 | 63000 | 95000 | 16 | 65 | 142 | 47 | 210 | 483 | 16 | 28 | 41 |
| 19,6 | 19,6 | 21,1 | 21,1 | 8800 | 3600 | 56000 | 85000 | 26 | 112 | 248 | 76 | 332 | 757 | 39 | 67 | 92 |
| 19,9 | 19,9 | 20,9 | 20,9 | 5100 | 2030 | 56000 | 85000 | 19 | 73 | 153 | 59 | 249 | 559 | 16 | 31 | 45 |
| 19,9 | 19,9 | 20,9 | 20,9 | 4850 | 1940 | 50000 | 75000 | 22 | 111 | 255 | 64 | 336 | 805 | 35 | 65 | 92 |
| 19,9 | 19,9 | 20,9 | 20,9 | 5100 | 1940 | 75000 | 120000 | 7 | 37 | 84 | 21 | 117 | 285 | 13 | 24 | 36 |
| 19,9 | 19,9 | 20,9 | 20,9 | 4850 | 1860 | 70000 | 110000 | 12 | 64 | 150 | 34 | 190 | 457 | 32 | 59 | 82 |

## 2.2.2 Spindle bearings

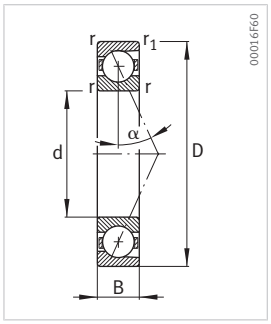
With large, medium or small balls

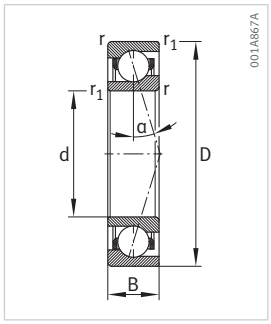
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

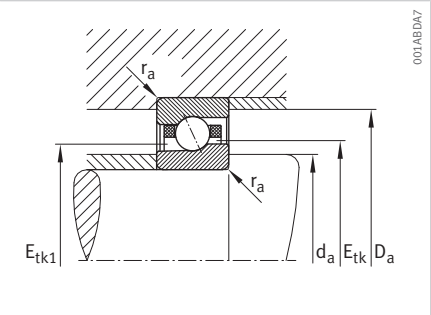
sealed



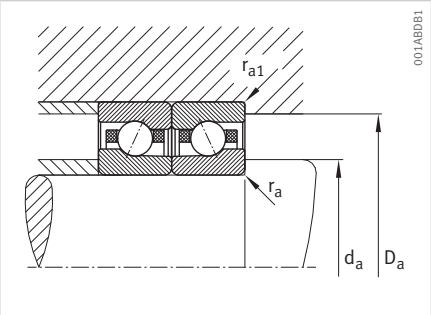




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HS71902-C-T-P4S** | • | 0,017 | 15 | 28 | 7 | 0,3 | 0,3 | 15 | 18 | 25,5 | 0,3 | 0,1 |
| **HS71902-E-T-P4S** | • | 0,017 | 15 | 28 | 7 | 0,3 | 0,3 | 25 | 18 | 25,5 | 0,3 | 0,1 |
| **HC71902-E-T-P4S** | • | 0,016 | 15 | 28 | 7 | 0,3 | 0,3 | 25 | 18 | 25,5 | 0,3 | 0,1 |
| **B7002-C-T-P4S** | • | 0,03 | 15 | 32 | 9 | 0,3 | 0,3 | 15 | 19 | 29 | 0,3 | 0,1 |
| **B7002-E-T-P4S** | • | 0,03 | 15 | 32 | 9 | 0,3 | 0,3 | 25 | 19 | 29 | 0,3 | 0,1 |
| **HCB7002-C-T-P4S** | • | 0,027 | 15 | 32 | 9 | 0,3 | 0,3 | 15 | 19 | 29 | 0,3 | 0,1 |
| **HCB7002-E-T-P4S** | • | 0,027 | 15 | 32 | 9 | 0,3 | 0,3 | 25 | 19 | 29 | 0,3 | 0,1 |
| **HS7002-C-T-P4S** | • | 0,033 | 15 | 32 | 9 | 0,3 | 0,3 | 15 | 19 | 29 | 0,3 | 0,1 |
| **HS7002-E-T-P4S** | • | 0,033 | 15 | 32 | 9 | 0,3 | 0,3 | 25 | 19 | 29 | 0,3 | 0,1 |
| **HC7002-E-T-P4S** | • | 0,031 | 15 | 32 | 9 | 0,3 | 0,3 | 25 | 19 | 29 | 0,3 | 0,1 |
| **B7202-C-T-P4S** | • | 0,044 | 15 | 35 | 11 | 0,6 | 0,6 | 15 | 19,5 | 30,5 | 0,6 | 0,3 |
| **B7202-E-T-P4S** | • | 0,044 | 15 | 35 | 11 | 0,6 | 0,6 | 25 | 19,5 | 30,5 | 0,6 | 0,3 |
| **HCB7202-C-T-P4S** | • | 0,038 | 15 | 35 | 11 | 0,6 | 0,6 | 15 | 19,5 | 30,5 | 0,6 | 0,3 |
| **HCB7202-E-T-P4S** | • | 0,038 | 15 | 35 | 11 | 0,6 | 0,6 | 25 | 19,5 | 30,5 | 0,6 | 0,3 |
| **B71903-C-T-P4S** | • | 0,018 | 17 | 30 | 7 | 0,3 | 0,3 | 15 | 20 | 27,5 | 0,3 | 0,1 |
| **B71903-E-T-P4S** | • | 0,018 | 17 | 30 | 7 | 0,3 | 0,3 | 25 | 20 | 27,5 | 0,3 | 0,1 |
| **HCB71903-C-T-P4S** | • | 0,015 | 17 | 30 | 7 | 0,3 | 0,3 | 15 | 20 | 27,5 | 0,3 | 0,1 |
| **HCB71903-E-T-P4S** | • | 0,015 | 17 | 30 | 7 | 0,3 | 0,3 | 25 | 20 | 27,5 | 0,3 | 0,1 |
| **HS71903-C-T-P4S** | • | 0,019 | 17 | 30 | 7 | 0,3 | 0,3 | 15 | 20 | 27,5 | 0,3 | 0,1 |
| **HS71903-E-T-P4S** | • | 0,019 | 17 | 30 | 7 | 0,3 | 0,3 | 25 | 20 | 27,5 | 0,3 | 0,1 |
| **HC71903-E-T-P4S** | • | 0,018 | 17 | 30 | 7 | 0,3 | 0,3 | 25 | 20 | 27,5 | 0,3 | 0,1 |
| **B7003-C-T-P4S** | • | 0,039 | 17 | 35 | 10 | 0,3 | 0,3 | 15 | 21 | 32 | 0,3 | 0,1 |
| **B7003-E-T-P4S** | • | 0,039 | 17 | 35 | 10 | 0,3 | 0,3 | 25 | 21 | 32 | 0,3 | 0,1 |
| **HCB7003-C-T-P4S** | • | 0,033 | 17 | 35 | 10 | 0,3 | 0,3 | 15 | 21 | 32 | 0,3 | 0,1 |
| **HCB7003-E-T-P4S** | • | 0,033 | 17 | 35 | 10 | 0,3 | 0,3 | 25 | 21 | 32 | 0,3 | 0,1 |
| **HS7003-C-T-P4S** | • | 0,04 | 17 | 35 | 10 | 0,3 | 0,3 | 15 | 21 | 32 | 0,3 | 0,1 |
| **HS7003-E-T-P4S** | • | 0,04 | 17 | 35 | 10 | 0,3 | 0,3 | 25 | 21 | 32 | 0,3 | 0,1 |
| **HC7003-E-T-P4S** | • | 0,038 | 17 | 35 | 10 | 0,3 | 0,3 | 25 | 21 | 32 | 0,3 | 0,1 |
| **B7203-C-T-P4S** | • | 0,063 | 17 | 40 | 12 | 0,6 | 0,6 | 15 | 22,5 | 34,5 | 0,6 | 0,3 |
| **B7203-E-T-P4S** | • | 0,062 | 17 | 40 | 12 | 0,6 | 0,6 | 25 | 22,5 | 34,5 | 0,6 | 0,3 |
| **HCB7203-C-T-P4S** | • | 0,056 | 17 | 40 | 12 | 0,6 | 0,6 | 15 | 22,5 | 34,5 | 0,6 | 0,3 |
| **HCB7203-E-T-P4S** | • | 0,055 | 17 | 40 | 12 | 0,6 | 0,6 | 25 | 22,5 | 34,5 | 0,6 | 0,3 |
| **B71904-C-T-P4S** | • | 0,037 | 20 | 37 | 9 | 0,3 | 0,3 | 15 | 24 | 33,5 | 0,3 | 0,15 |
| **B71904-E-T-P4S** | • | 0,037 | 20 | 37 | 9 | 0,3 | 0,3 | 25 | 24 | 33,5 | 0,3 | 0,15 |
| **HCB71904-C-T-P4S** | • | 0,033 | 20 | 37 | 9 | 0,3 | 0,3 | 15 | 24 | 33,5 | 0,3 | 0,15 |
| **HCB71904-E-T-P4S** | • | 0,033 | 20 | 37 | 9 | 0,3 | 0,3 | 25 | 24 | 33,5 | 0,3 | 0,15 |
| **HS71904-C-T-P4S** | • | 0,04 | 20 | 37 | 9 | 0,3 | 0,3 | 15 | 24 | 33,5 | 0,3 | 0,15 |
| **HS71904-E-T-P4S** | • | 0,04 | 20 | 37 | 9 | 0,3 | 0,3 | 25 | 24 | 33,5 | 0,3 | 0,15 |
| **HC71904-E-T-P4S** | • | 0,039 | 20 | 37 | 9 | 0,3 | 0,3 | 25 | 24 | 33,5 | 0,3 | 0,15 |
| **B7004-C-T-P4S** | • | 0,067 | 20 | 42 | 12 | 0,6 | 0,6 | 15 | 25 | 37 | 0,6 | 0,3 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 19,9 | 18,8 | 20,4 | 20,4 | 2550 | 1040 | 75000 | 110000 | 9 | 28 | 56 | 28 | 90 | 188 | 11 | 18 | 25 |
| 19,9 | 18,8 | 20,4 | 20,4 | 2410 | 990 | 67000 | 100000 | 15 | 46 | 91 | 44 | 136 | 278 | 28 | 42 | 56 |
| 19,9 | 18,8 | 20,4 | 20,4 | 2410 | 950 | 85000 | 130000 | 11 | 32 | 63 | 30 | 92 | 188 | 28 | 42 | 54 |
| 21,1 | 21,1 | 22,3 | 22,3 | 6100 | 2410 | 53000 | 80000 | 27 | 99 | 204 | 84 | 332 | 733 | 17 | 30 | 43 |
| 21,1 | 21,1 | 22,3 | 22,3 | 5900 | 2310 | 45000 | 70000 | 36 | 154 | 341 | 104 | 464 | 1066 | 37 | 65 | 90 |
| 21,1 | 21,1 | 22,3 | 22,3 | 6200 | 2310 | 70000 | 110000 | 12 | 52 | 114 | 35 | 164 | 381 | 13 | 24 | 35 |
| 21,1 | 21,1 | 22,3 | 22,3 | 5900 | 2210 | 63000 | 100000 | 20 | 88 | 199 | 57 | 260 | 600 | 34 | 59 | 80 |
| 21,6 | 20,4 | 22,4 | 22,4 | 3450 | 1480 | 70000 | 110000 | 13 | 38 | 75 | 38 | 120 | 251 | 14 | 22 | 30 |
| 21,6 | 20,4 | 22,4 | 22,4 | 3250 | 1410 | 63000 | 95000 | 20 | 61 | 122 | 59 | 182 | 372 | 34 | 51 | 67 |
| 21,6 | 20,4 | 22,4 | 22,4 | 3250 | 1350 | 80000 | 120000 | 14 | 42 | 85 | 41 | 124 | 252 | 34 | 50 | 65 |
| 21,7 | 21,7 | 23,4 | 23,4 | 11600 | 5000 | 45000 | 67000 | 46 | 158 | 319 | 144 | 543 | 1177 | 22 | 39 | 57 |
| 21,7 | 21,7 | 23,4 | 23,4 | 11100 | 4850 | 40000 | 60000 | 64 | 252 | 546 | 187 | 768 | 1732 | 50 | 84 | 117 |
| 21,7 | 21,7 | 23,4 | 23,4 | 11600 | 4800 | 56000 | 85000 | 22 | 86 | 183 | 65 | 275 | 626 | 18 | 32 | 47 |
| 21,7 | 21,7 | 23,4 | 23,4 | 11100 | 4650 | 48000 | 70000 | 24 | 126 | 291 | 70 | 371 | 884 | 40 | 72 | 100 |
| 21,4 | 21,4 | 22,3 | 22,3 | 5300 | 2230 | 50000 | 80000 | 20 | 78 | 162 | 62 | 263 | 592 | 18 | 33 | 48 |
| 21,4 | 21,4 | 22,3 | 22,3 | 5100 | 2120 | 45000 | 70000 | 22 | 115 | 265 | 65 | 346 | 833 | 37 | 69 | 97 |
| 21,4 | 21,4 | 22,3 | 22,3 | 5300 | 2130 | 70000 | 110000 | 8 | 39 | 89 | 22 | 123 | 300 | 13 | 26 | 38 |
| 21,4 | 21,4 | 22,3 | 22,3 | 5100 | 2030 | 63000 | 100000 | 12 | 65 | 154 | 34 | 193 | 466 | 33 | 62 | 86 |
| 21,9 | 20,8 | 22,4 | 22,4 | 2600 | 1130 | 70000 | 110000 | 10 | 29 | 58 | 29 | 93 | 194 | 12 | 19 | 27 |
| 21,9 | 20,8 | 22,4 | 22,4 | 2480 | 1070 | 63000 | 95000 | 16 | 47 | 93 | 45 | 138 | 283 | 30 | 44 | 58 |
| 21,9 | 20,8 | 22,4 | 22,4 | 2480 | 1030 | 80000 | 120000 | 11 | 33 | 66 | 31 | 96 | 195 | 30 | 44 | 57 |
| 23,3 | 23,3 | 24,5 | 24,5 | 8600 | 3500 | 45000 | 70000 | 40 | 142 | 291 | 124 | 474 | 1042 | 21 | 37 | 54 |
| 23,3 | 23,3 | 24,5 | 24,5 | 8200 | 3350 | 43000 | 63000 | 54 | 220 | 483 | 156 | 663 | 1504 | 48 | 81 | 112 |
| 23,3 | 23,3 | 24,5 | 24,5 | 8600 | 3350 | 63000 | 100000 | 18 | 75 | 164 | 54 | 237 | 546 | 17 | 31 | 44 |
| 23,3 | 23,3 | 24,5 | 24,5 | 8200 | 3250 | 56000 | 90000 | 30 | 126 | 279 | 85 | 370 | 840 | 44 | 73 | 100 |
| 24,1 | 22,9 | 24,8 | 24,8 | 3550 | 1600 | 63000 | 95000 | 13 | 38 | 76 | 38 | 121 | 253 | 14 | 23 | 31 |
| 24,1 | 22,9 | 24,8 | 24,8 | 3350 | 1520 | 56000 | 85000 | 21 | 63 | 126 | 61 | 187 | 382 | 36 | 53 | 70 |
| 24,1 | 22,9 | 24,8 | 24,8 | 3350 | 1460 | 75000 | 110000 | 14 | 43 | 86 | 41 | 126 | 256 | 35 | 52 | 68 |
| 25 | 25 | 26,7 | 26,7 | 13000 | 5800 | 38000 | 56000 | 53 | 179 | 360 | 165 | 614 | 1327 | 24 | 42 | 61 |
| 25 | 25 | 26,7 | 26,7 | 12400 | 5600 | 36000 | 53000 | 74 | 286 | 616 | 216 | 871 | 1954 | 53 | 90 | 125 |
| 25 | 25 | 26,7 | 26,7 | 13000 | 5600 | 50000 | 75000 | 25 | 97 | 208 | 75 | 313 | 708 | 20 | 34 | 50 |
| 25 | 25 | 26,7 | 26,7 | 12500 | 5400 | 43000 | 63000 | 29 | 145 | 332 | 84 | 428 | 1011 | 43 | 77 | 107 |
| 26 | 26 | 27,1 | 27,1 | 7400 | 3200 | 43000 | 63000 | 31 | 113 | 233 | 95 | 384 | 851 | 22 | 39 | 57 |
| 26 | 26 | 27,1 | 27,1 | 7000 | 3050 | 38000 | 60000 | 37 | 170 | 384 | 108 | 516 | 1208 | 47 | 83 | 117 |
| 26 | 26 | 27,1 | 27,1 | 7400 | 3100 | 60000 | 90000 | 12 | 57 | 128 | 37 | 182 | 431 | 17 | 32 | 46 |
| 26 | 26 | 27,1 | 27,1 | 7000 | 2950 | 53000 | 80000 | 20 | 98 | 223 | 58 | 289 | 678 | 43 | 75 | 104 |
| 26,6 | 25,4 | 27,2 | 27,2 | 3600 | 1730 | 56000 | 90000 | 13 | 39 | 78 | 39 | 124 | 259 | 15 | 24 | 33 |
| 26,6 | 25,4 | 27,2 | 27,2 | 3400 | 1630 | 53000 | 80000 | 22 | 65 | 129 | 62 | 191 | 392 | 37 | 56 | 73 |
| 26,6 | 25,4 | 27,2 | 27,2 | 3400 | 1560 | 67000 | 100000 | 15 | 44 | 88 | 42 | 128 | 261 | 37 | 55 | 71 |
| 27,8 | 27,8 | 29,3 | 29,3 | 10300 | 4250 | 38000 | 60000 | 51 | 175 | 356 | 157 | 586 | 1276 | 23 | 39 | 57 |

## 2.2.2 Spindle bearings

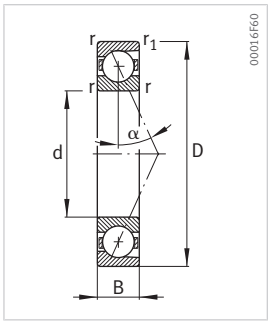
With large, medium or small balls

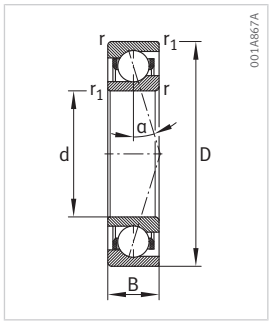
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

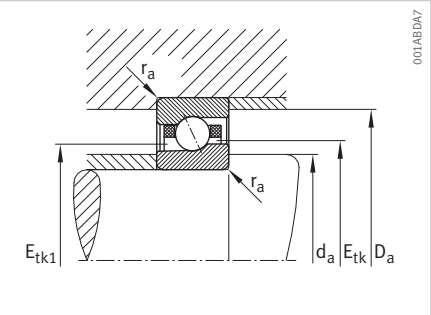
sealed



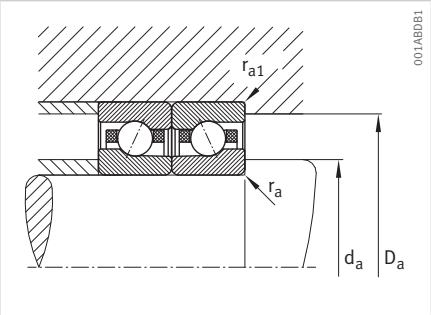




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B7004-E-T-P4S** | • | 0,067 | 20 | 42 | 12 | 0,6 | 0,6 | 25 | 25 | 37 | 0,6 | 0,3 |
| **HCB7004-C-T-P4S** | • | 0,061 | 20 | 42 | 12 | 0,6 | 0,6 | 15 | 25 | 37 | 0,6 | 0,3 |
| **HCB7004-E-T-P4S** | • | 0,061 | 20 | 42 | 12 | 0,6 | 0,6 | 25 | 25 | 37 | 0,6 | 0,3 |
| **HS7004-C-T-P4S** | • | 0,077 | 20 | 42 | 12 | 0,6 | 0,6 | 15 | 25 | 37 | 0,6 | 0,3 |
| **HS7004-E-T-P4S** | • | 0,077 | 20 | 42 | 12 | 0,6 | 0,6 | 25 | 25 | 37 | 0,6 | 0,3 |
| **HC7004-E-T-P4S** | • | 0,073 | 20 | 42 | 12 | 0,6 | 0,6 | 25 | 25 | 37 | 0,6 | 0,3 |
| **B7204-C-T-P4S** | • | 0,103 | 20 | 47 | 14 | 1 | 1 | 15 | 26,5 | 40,5 | 1 | 0,3 |
| **B7204-E-T-P4S** | • | 0,103 | 20 | 47 | 14 | 1 | 1 | 25 | 26,5 | 40,5 | 1 | 0,3 |
| **HCB7204-C-T-P4S** | • | 0,092 | 20 | 47 | 14 | 1 | 1 | 15 | 26,5 | 40,5 | 1 | 0,3 |
| **HCB7204-E-T-P4S** | • | 0,091 | 20 | 47 | 14 | 1 | 1 | 25 | 26,5 | 40,5 | 1 | 0,3 |
| **B71905-C-T-P4S** | • | 0,043 | 25 | 42 | 9 | 0,3 | 0,3 | 15 | 29 | 38,5 | 0,3 | 0,15 |
| **B71905-E-T-P4S** | • | 0,043 | 25 | 42 | 9 | 0,3 | 0,3 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **HCB71905-C-T-P4S** | • | 0,039 | 25 | 42 | 9 | 0,3 | 0,3 | 15 | 29 | 38,5 | 0,3 | 0,15 |
| **HCB71905-E-T-P4S** | • | 0,039 | 25 | 42 | 9 | 0,3 | 0,3 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **HS71905-C-T-P4S** | • | 0,046 | 25 | 42 | 9 | 0,3 | 0,3 | 15 | 29 | 38,5 | 0,3 | 0,15 |
| **HS71905-E-T-P4S** | • | 0,046 | 25 | 42 | 9 | 0,3 | 0,3 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **HC71905-E-T-P4S** | • | 0,045 | 25 | 42 | 9 | 0,3 | 0,3 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **M71905-C-T-P4S-XL** | • | 0,038 | 25 | 42 | 9 | 0,3 | 0,15 | 17 | 29 | 38,5 | 0,3 | 0,15 |
| **M71905-E-T-P4S-XL** | • | 0,038 | 25 | 42 | 9 | 0,3 | 0,15 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **HCM71905-C-T-P4S-XL** | • | 0,034 | 25 | 42 | 9 | 0,3 | 0,15 | 17 | 29 | 38,5 | 0,3 | 0,15 |
| **HCM71905-E-T-P4S-XL** | • | 0,034 | 25 | 42 | 9 | 0,3 | 0,15 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **VCM71905-C-T-P4S-XL** | • | 0,034 | 25 | 42 | 9 | 0,3 | 0,15 | 17 | 29 | 38,5 | 0,3 | 0,15 |
| **VCM71905-E-T-P4S-XL** | • | 0,034 | 25 | 42 | 9 | 0,3 | 0,15 | 25 | 29 | 38,5 | 0,3 | 0,15 |
| **B7005-C-T-P4S** | • | 0,077 | 25 | 47 | 12 | 0,6 | 0,6 | 15 | 30 | 42 | 0,6 | 0,3 |
| **B7005-E-T-P4S** | • | 0,077 | 25 | 47 | 12 | 0,6 | 0,6 | 25 | 30 | 42 | 0,6 | 0,3 |
| **HCB7005-C-T-P4S** | • | 0,065 | 25 | 47 | 12 | 0,6 | 0,6 | 15 | 30 | 42 | 0,6 | 0,3 |
| **HCB7005-E-T-P4S** | • | 0,065 | 25 | 47 | 12 | 0,6 | 0,6 | 25 | 30 | 42 | 0,6 | 0,3 |
| **HS7005-C-T-P4S** | • | 0,087 | 25 | 47 | 12 | 0,6 | 0,6 | 15 | 30 | 42 | 0,6 | 0,3 |
| **HS7005-E-T-P4S** | • | 0,087 | 25 | 47 | 12 | 0,6 | 0,6 | 25 | 30 | 42 | 0,6 | 0,3 |
| **HC7005-E-T-P4S** | • | 0,084 | 25 | 47 | 12 | 0,6 | 0,6 | 25 | 30 | 42 | 0,6 | 0,3 |
| **M7005-C-T-P4S-XL** | • | 0,076 | 25 | 47 | 12 | 0,6 | 0,3 | 17 | 30 | 42 | 0,6 | 0,3 |
| **M7005-E-T-P4S-XL** | • | 0,076 | 25 | 47 | 12 | 0,6 | 0,3 | 25 | 30 | 42 | 0,6 | 0,3 |
| **HCM7005-C-T-P4S-XL** | • | 0,069 | 25 | 47 | 12 | 0,6 | 0,3 | 17 | 30 | 42 | 0,6 | 0,3 |
| **HCM7005-E-T-P4S-XL** | • | 0,069 | 25 | 47 | 12 | 0,6 | 0,3 | 25 | 30 | 42 | 0,6 | 0,3 |
| **VCM7005-C-T-P4S-XL** | • | 0,069 | 25 | 47 | 12 | 0,6 | 0,3 | 17 | 30 | 42 | 0,6 | 0,3 |
| **VCM7005-E-T-P4S-XL** | • | 0,069 | 25 | 47 | 12 | 0,6 | 0,3 | 25 | 30 | 42 | 0,6 | 0,3 |
| **B7205-C-T-P4S** | • | 0,127 | 25 | 52 | 15 | 1 | 1 | 15 | 31,5 | 45,5 | 1 | 0,3 |
| **B7205-E-T-P4S** | • | 0,127 | 25 | 52 | 15 | 1 | 1 | 25 | 31,5 | 45,5 | 1 | 0,3 |
| **HCB7205-C-T-P4S** | • | 0,114 | 25 | 52 | 15 | 1 | 1 | 15 | 31,5 | 45,5 | 1 | 0,3 |
| **HCB7205-E-T-P4S** | • | 0,114 | 25 | 52 | 15 | 1 | 1 | 25 | 31,5 | 45,5 | 1 | 0,3 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 27,8 | 27,8 | 29,3 | 29,3 | 9800 | 4050 | 34000 | 53000 | 71 | 275 | 595 | 205 | 829 | 1857 | 52 | 86 | 119 |
| 27,8 | 27,8 | 29,3 | 29,3 | 10300 | 4050 | 53000 | 80000 | 24 | 94 | 202 | 72 | 297 | 673 | 19 | 33 | 47 |
| 27,8 | 27,8 | 29,3 | 29,3 | 9800 | 3900 | 48000 | 75000 | 28 | 140 | 321 | 80 | 410 | 966 | 42 | 75 | 103 |
| 28,6 | 27,1 | 29,7 | 29,7 | 5700 | 2700 | 53000 | 80000 | 21 | 62 | 125 | 63 | 198 | 413 | 20 | 32 | 44 |
| 28,6 | 27,1 | 29,7 | 29,7 | 5400 | 2600 | 48000 | 75000 | 34 | 101 | 202 | 97 | 299 | 611 | 49 | 74 | 96 |
| 28,6 | 27,1 | 29,7 | 29,7 | 5400 | 2470 | 60000 | 95000 | 23 | 70 | 140 | 67 | 204 | 415 | 49 | 72 | 94 |
| 29,6 | 29,6 | 31,7 | 31,7 | 17200 | 8000 | 32000 | 48000 | 75 | 248 | 496 | 234 | 851 | 1828 | 28 | 49 | 71 |
| 29,6 | 29,6 | 31,7 | 31,7 | 16500 | 7700 | 30000 | 45000 | 107 | 398 | 848 | 313 | 1212 | 2686 | 64 | 106 | 146 |
| 29,6 | 29,6 | 31,7 | 31,7 | 17300 | 7600 | 40000 | 60000 | 36 | 135 | 284 | 109 | 432 | 967 | 23 | 41 | 58 |
| 29,6 | 29,6 | 31,7 | 31,7 | 16500 | 7300 | 36000 | 53000 | 46 | 205 | 460 | 131 | 606 | 1400 | 53 | 92 | 126 |
| 31 | 31 | 32 | 32 | 8000 | 3800 | 36000 | 56000 | 34 | 127 | 265 | 102 | 418 | 934 | 25 | 45 | 66 |
| 31 | 31 | 32 | 32 | 7600 | 3600 | 32000 | 50000 | 41 | 191 | 432 | 115 | 566 | 1335 | 54 | 97 | 137 |
| 31 | 31 | 32 | 32 | 8000 | 3650 | 50000 | 75000 | 14 | 65 | 145 | 39 | 199 | 475 | 19 | 37 | 53 |
| 31 | 31 | 32 | 32 | 7600 | 3450 | 45000 | 67000 | 22 | 107 | 246 | 60 | 310 | 735 | 49 | 87 | 121 |
| 31,6 | 30,4 | 32,2 | 32,2 | 3900 | 2060 | 48000 | 75000 | 14 | 43 | 85 | 43 | 135 | 282 | 17 | 27 | 37 |
| 31,6 | 30,4 | 32,2 | 32,2 | 3650 | 1950 | 43000 | 67000 | 23 | 69 | 138 | 66 | 204 | 416 | 42 | 63 | 82 |
| 31,6 | 30,4 | 32,2 | 32,2 | 3650 | 1870 | 56000 | 85000 | 16 | 47 | 95 | 45 | 138 | 281 | 42 | 62 | 80 |
| 31 | 28,9 | 32 | 32 | 6500 | 2750 | 50000 | 75000 | 29 | 78 | 163 | 86 | 235 | 514 | 24 | 35 | 48 |
| 31 | 28,9 | 32 | 32 | 6300 | 2650 | 45000 | 70000 | 42 | 110 | 229 | 121 | 321 | 682 | 48 | 68 | 89 |
| 31 | 28,9 | 32 | 32 | 6600 | 2650 | 60000 | 90000 | 21 | 54 | 114 | 60 | 161 | 348 | 24 | 34 | 45 |
| 31 | 28,9 | 32 | 32 | 6300 | 2550 | 60000 | 85000 | 30 | 77 | 161 | 85 | 224 | 472 | 48 | 67 | 88 |
| 31 | 28,9 | 32 | 32 | 15700 | 3700 | 63000 | 100000 | 18 | 49 | 102 | 54 | 144 | 310 | 23 | 33 | 45 |
| 31 | 28,9 | 32 | 32 | 15100 | 3550 | 60000 | 90000 | 27 | 70 | 145 | 76 | 201 | 422 | 48 | 67 | 87 |
| 32,5 | 32,5 | 34,1 | 34,1 | 13700 | 5900 | 34000 | 50000 | 73 | 248 | 502 | 226 | 831 | 1807 | 30 | 51 | 74 |
| 32,5 | 32,5 | 34,1 | 34,1 | 13100 | 5600 | 30000 | 45000 | 99 | 381 | 820 | 290 | 1150 | 2560 | 67 | 112 | 153 |
| 32,5 | 32,5 | 34,1 | 34,1 | 13700 | 5600 | 45000 | 70000 | 35 | 132 | 283 | 104 | 419 | 944 | 25 | 43 | 60 |
| 32,5 | 32,5 | 34,1 | 34,1 | 13100 | 5400 | 40000 | 63000 | 40 | 194 | 443 | 117 | 573 | 1338 | 55 | 97 | 133 |
| 33,6 | 32,2 | 34,5 | 34,5 | 5800 | 3000 | 45000 | 70000 | 21 | 63 | 127 | 64 | 201 | 419 | 21 | 33 | 45 |
| 33,6 | 32,2 | 34,5 | 34,5 | 5500 | 2800 | 40000 | 63000 | 35 | 104 | 207 | 100 | 306 | 626 | 51 | 77 | 100 |
| 33,6 | 32,2 | 34,5 | 34,5 | 5500 | 2700 | 53000 | 80000 | 23 | 70 | 140 | 67 | 204 | 415 | 50 | 75 | 97 |
| 32,7 | 30,6 | 34,4 | 34,4 | 8000 | 3250 | 45000 | 70000 | 34 | 91 | 191 | 101 | 275 | 601 | 24 | 35 | 48 |
| 32,7 | 30,6 | 34,4 | 34,4 | 7700 | 3150 | 43000 | 63000 | 49 | 130 | 270 | 142 | 378 | 802 | 49 | 69 | 91 |
| 32,7 | 30,6 | 34,4 | 34,4 | 8000 | 3150 | 56000 | 85000 | 24 | 64 | 133 | 70 | 189 | 407 | 24 | 34 | 46 |
| 32,7 | 30,6 | 34,4 | 34,4 | 7700 | 3000 | 53000 | 80000 | 35 | 91 | 190 | 100 | 264 | 555 | 49 | 69 | 90 |
| 32,7 | 30,6 | 34,4 | 34,4 | 19200 | 4400 | 60000 | 90000 | 22 | 57 | 119 | 63 | 169 | 362 | 24 | 34 | 46 |
| 32,7 | 30,6 | 34,4 | 34,4 | 18400 | 4200 | 56000 | 85000 | 31 | 82 | 170 | 90 | 236 | 497 | 49 | 68 | 89 |
| 34,4 | 34,4 | 36,5 | 36,5 | 14800 | 6100 | 28000 | 43000 | 80 | 265 | 531 | 248 | 906 | 1949 | 30 | 53 | 77 |
| 34,4 | 34,4 | 36,5 | 36,5 | 14200 | 5800 | 26000 | 40000 | 114 | 425 | 907 | 333 | 1293 | 2868 | 69 | 115 | 159 |
| 34,4 | 34,4 | 36,5 | 36,5 | 14800 | 5800 | 36000 | 53000 | 40 | 147 | 311 | 117 | 465 | 1042 | 25 | 44 | 63 |
| 34,4 | 34,4 | 36,5 | 36,5 | 14200 | 5600 | 32000 | 48000 | 50 | 223 | 500 | 140 | 650 | 1504 | 58 | 100 | 137 |

## 2.2.2 Spindle bearings

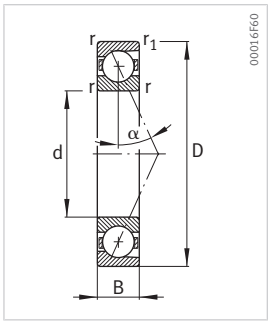
With large, medium or small balls

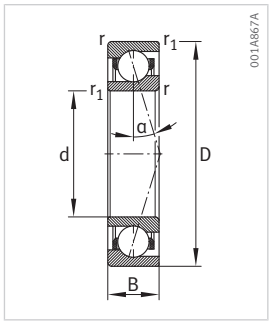
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

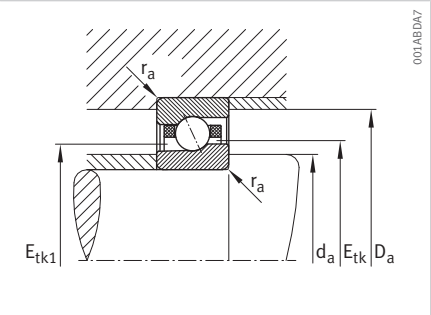
sealed



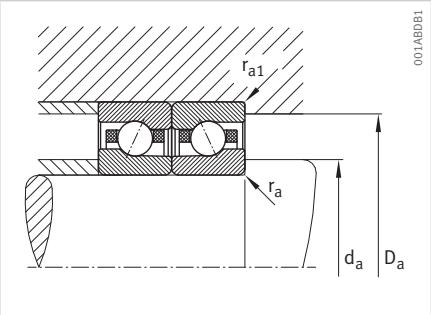




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B71906-C-T-P4S** | • | 0,05 | 30 | 47 | 9 | 0,3 | 0,3 | 15 | 34 | 43,5 | 0,3 | 0,15 |
| **B71906-E-T-P4S** | • | 0,05 | 30 | 47 | 9 | 0,3 | 0,3 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **HCB71906-C-T-P4S** | • | 0,045 | 30 | 47 | 9 | 0,3 | 0,3 | 15 | 34 | 43,5 | 0,3 | 0,15 |
| **HCB71906-E-T-P4S** | • | 0,045 | 30 | 47 | 9 | 0,3 | 0,3 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **HS71906-C-T-P4S** | • | 0,05 | 30 | 47 | 9 | 0,3 | 0,3 | 15 | 34 | 43,5 | 0,3 | 0,15 |
| **HS71906-E-T-P4S** | • | 0,05 | 30 | 47 | 9 | 0,3 | 0,3 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **HC71906-E-T-P4S** | • | 0,046 | 30 | 47 | 9 | 0,3 | 0,3 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **M71906-C-T-P4S-XL** | • | 0,044 | 30 | 47 | 9 | 0,3 | 0,15 | 17 | 34 | 43,5 | 0,3 | 0,15 |
| **M71906-E-T-P4S-XL** | • | 0,044 | 30 | 47 | 9 | 0,3 | 0,15 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **HCM71906-C-T-P4S-XL** | • | 0,039 | 30 | 47 | 9 | 0,3 | 0,15 | 17 | 34 | 43,5 | 0,3 | 0,15 |
| **HCM71906-E-T-P4S-XL** | • | 0,039 | 30 | 47 | 9 | 0,3 | 0,15 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **VCM71906-C-T-P4S-XL** | • | 0,039 | 30 | 47 | 9 | 0,3 | 0,15 | 17 | 34 | 43,5 | 0,3 | 0,15 |
| **VCM71906-E-T-P4S-XL** | • | 0,039 | 30 | 47 | 9 | 0,3 | 0,15 | 25 | 34 | 43,5 | 0,3 | 0,15 |
| **B7006-C-T-P4S** | • | 0,114 | 30 | 55 | 13 | 1 | 1 | 15 | 36 | 49 | 1 | 0,3 |
| **B7006-E-T-P4S** | • | 0,114 | 30 | 55 | 13 | 1 | 1 | 25 | 36 | 49 | 1 | 0,3 |
| **HCB7006-C-T-P4S** | • | 0,101 | 30 | 55 | 13 | 1 | 1 | 15 | 36 | 49 | 1 | 0,3 |
| **HCB7006-E-T-P4S** | • | 0,101 | 30 | 55 | 13 | 1 | 1 | 25 | 36 | 49 | 1 | 0,3 |
| **HS7006-C-T-P4S** | • | 0,124 | 30 | 55 | 13 | 1 | 1 | 15 | 36 | 49 | 1 | 0,3 |
| **HS7006-E-T-P4S** | • | 0,124 | 30 | 55 | 13 | 1 | 1 | 25 | 36 | 49 | 1 | 0,3 |
| **HC7006-E-T-P4S** | • | 0,119 | 30 | 55 | 13 | 1 | 1 | 25 | 36 | 49 | 1 | 0,3 |
| **M7006-C-T-P4S-XL** | • | 0,12 | 30 | 55 | 13 | 1 | 0,6 | 17 | 36 | 49 | 1 | 0,3 |
| **M7006-E-T-P4S-XL** | • | 0,12 | 30 | 55 | 13 | 1 | 0,6 | 25 | 36 | 49 | 1 | 0,3 |
| **HCM7006-C-T-P4S-XL** | • | 0,11 | 30 | 55 | 13 | 1 | 0,6 | 17 | 36 | 49 | 1 | 0,3 |
| **HCM7006-E-T-P4S-XL** | • | 0,11 | 30 | 55 | 13 | 1 | 0,6 | 25 | 36 | 49 | 1 | 0,3 |
| **VCM7006-C-T-P4S-XL** | • | 0,11 | 30 | 55 | 13 | 1 | 0,6 | 17 | 36 | 49 | 1 | 0,3 |
| **VCM7006-E-T-P4S-XL** | • | 0,11 | 30 | 55 | 13 | 1 | 0,6 | 25 | 36 | 49 | 1 | 0,3 |
| **B7206-C-T-P4S** | • | 0,197 | 30 | 62 | 16 | 1 | 1 | 15 | 37,5 | 54,5 | 1 | 0,3 |
| **B7206-E-T-P4S** | • | 0,197 | 30 | 62 | 16 | 1 | 1 | 25 | 37,5 | 54,5 | 1 | 0,3 |
| **HCB7206-C-T-P4S** | • | 0,172 | 30 | 62 | 16 | 1 | 1 | 15 | 37,5 | 54,5 | 1 | 0,3 |
| **HCB7206-E-T-P4S** | • | 0,172 | 30 | 62 | 16 | 1 | 1 | 25 | 37,5 | 54,5 | 1 | 0,3 |
| **B71907-C-T-P4S** | • | 0,077 | 35 | 55 | 10 | 0,6 | 0,6 | 15 | 40 | 51,5 | 0,6 | 0,15 |
| **B71907-E-T-P4S** | • | 0,077 | 35 | 55 | 10 | 0,6 | 0,6 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **HCB71907-C-T-P4S** | • | 0,067 | 35 | 55 | 10 | 0,6 | 0,6 | 15 | 40 | 51,5 | 0,6 | 0,15 |
| **HCB71907-E-T-P4S** | • | 0,067 | 35 | 55 | 10 | 0,6 | 0,6 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **HS71907-C-T-P4S** | • | 0,081 | 35 | 55 | 10 | 0,6 | 0,6 | 15 | 40 | 51,5 | 0,6 | 0,15 |
| **HS71907-E-T-P4S** | • | 0,081 | 35 | 55 | 10 | 0,6 | 0,6 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **HC71907-E-T-P4S** | • | 0,076 | 35 | 55 | 10 | 0,6 | 0,6 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **M71907-C-T-P4S-XL** | • | 0,069 | 35 | 55 | 10 | 0,6 | 0,3 | 17 | 40 | 51,5 | 0,6 | 0,15 |
| **M71907-E-T-P4S-XL** | • | 0,069 | 35 | 55 | 10 | 0,6 | 0,3 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **HCM71907-C-T-P4S-XL** | • | 0,061 | 35 | 55 | 10 | 0,6 | 0,3 | 17 | 40 | 51,5 | 0,6 | 0,15 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 36 | 36 | 37 | 37 | 8500 | 4350 | 30000 | 48000 | 36 | 134 | 281 | 106 | 439 | 985 | 27 | 49 | 72 |
| 36 | 36 | 37 | 37 | 8100 | 4150 | 28000 | 43000 | 41 | 197 | 448 | 114 | 580 | 1377 | 58 | 105 | 148 |
| 36 | 36 | 37 | 37 | 8500 | 4200 | 43000 | 67000 | 14 | 68 | 155 | 40 | 210 | 504 | 21 | 40 | 58 |
| 36 | 36 | 37 | 37 | 8100 | 3950 | 38000 | 60000 | 22 | 112 | 258 | 60 | 322 | 768 | 53 | 95 | 132 |
| 36,1 | 34,7 | 37 | 37 | 5900 | 3100 | 43000 | 63000 | 21 | 64 | 129 | 65 | 204 | 425 | 21 | 34 | 47 |
| 36,1 | 34,7 | 37 | 37 | 5600 | 2950 | 38000 | 60000 | 35 | 104 | 207 | 100 | 306 | 625 | 53 | 79 | 103 |
| 36,1 | 34,7 | 37 | 37 | 5600 | 2850 | 48000 | 75000 | 24 | 72 | 143 | 69 | 209 | 425 | 53 | 78 | 101 |
| 35,7 | 33,9 | 37 | 37 | 6900 | 3200 | 43000 | 63000 | 34 | 89 | 188 | 99 | 270 | 592 | 27 | 39 | 54 |
| 35,7 | 33,9 | 37 | 37 | 6600 | 3050 | 40000 | 60000 | 48 | 126 | 263 | 138 | 368 | 782 | 54 | 76 | 100 |
| 35,7 | 33,9 | 37 | 37 | 6900 | 3050 | 53000 | 80000 | 24 | 62 | 131 | 69 | 186 | 400 | 27 | 38 | 51 |
| 35,7 | 33,9 | 37 | 37 | 6600 | 2900 | 50000 | 75000 | 34 | 89 | 185 | 97 | 257 | 541 | 54 | 76 | 99 |
| 35,7 | 33,9 | 37 | 37 | 16700 | 4250 | 56000 | 85000 | 21 | 56 | 117 | 62 | 166 | 356 | 26 | 38 | 51 |
| 35,7 | 33,9 | 37 | 37 | 15900 | 4100 | 53000 | 80000 | 30 | 80 | 166 | 87 | 230 | 484 | 54 | 75 | 98 |
| 39,4 | 39,4 | 40,6 | 40,6 | 14400 | 6700 | 28000 | 43000 | 74 | 254 | 516 | 228 | 848 | 1844 | 32 | 57 | 82 |
| 39,4 | 39,4 | 40,6 | 40,6 | 13700 | 6400 | 24000 | 38000 | 102 | 396 | 854 | 294 | 1188 | 2661 | 74 | 123 | 170 |
| 39,4 | 39,4 | 40,6 | 40,6 | 14400 | 6400 | 38000 | 60000 | 35 | 137 | 293 | 104 | 431 | 976 | 27 | 47 | 67 |
| 39,4 | 39,4 | 40,6 | 40,6 | 13700 | 6100 | 34000 | 53000 | 42 | 203 | 465 | 117 | 592 | 1395 | 60 | 107 | 147 |
| 39,7 | 37,9 | 40,9 | 40,9 | 8200 | 4250 | 38000 | 56000 | 29 | 88 | 177 | 89 | 280 | 584 | 24 | 39 | 53 |
| 39,7 | 37,9 | 40,9 | 40,9 | 7800 | 4050 | 34000 | 53000 | 48 | 143 | 286 | 138 | 423 | 865 | 61 | 91 | 119 |
| 39,7 | 37,9 | 40,9 | 40,9 | 7800 | 3850 | 43000 | 67000 | 33 | 98 | 197 | 94 | 287 | 583 | 60 | 89 | 115 |
| 39,2 | 37,1 | 40,9 | 40,9 | 8900 | 4050 | 38000 | 60000 | 43 | 113 | 238 | 125 | 342 | 749 | 29 | 43 | 59 |
| 39,2 | 37,1 | 40,9 | 40,9 | 8500 | 3900 | 36000 | 53000 | 61 | 161 | 335 | 176 | 469 | 995 | 59 | 84 | 110 |
| 39,2 | 37,1 | 40,9 | 40,9 | 8900 | 3900 | 48000 | 70000 | 30 | 79 | 166 | 87 | 235 | 507 | 29 | 42 | 56 |
| 39,2 | 37,1 | 40,9 | 40,9 | 8500 | 3700 | 45000 | 67000 | 43 | 113 | 235 | 124 | 327 | 689 | 59 | 83 | 109 |
| 39,2 | 37,1 | 40,9 | 40,9 | 21400 | 5400 | 50000 | 80000 | 27 | 71 | 148 | 78 | 210 | 450 | 29 | 41 | 55 |
| 39,2 | 37,1 | 40,9 | 40,9 | 20400 | 5200 | 48000 | 70000 | 39 | 102 | 211 | 111 | 293 | 616 | 59 | 83 | 108 |
| 41,2 | 41,2 | 43,7 | 43,7 | 23100 | 10400 | 24000 | 38000 | 123 | 404 | 806 | 385 | 1375 | 2945 | 40 | 69 | 99 |
| 41,2 | 41,2 | 43,7 | 43,7 | 22100 | 9900 | 22000 | 36000 | 177 | 641 | 1355 | 518 | 1946 | 4271 | 90 | 148 | 203 |
| 41,2 | 41,2 | 43,7 | 43,7 | 23100 | 9900 | 30000 | 45000 | 62 | 222 | 465 | 185 | 711 | 1576 | 33 | 57 | 81 |
| 41,2 | 41,2 | 43,7 | 43,7 | 22200 | 9500 | 26000 | 40000 | 80 | 339 | 749 | 231 | 1001 | 2273 | 77 | 130 | 177 |
| 42,6 | 42,6 | 44 | 44 | 12100 | 6800 | 26000 | 40000 | 50 | 185 | 384 | 155 | 619 | 1377 | 34 | 60 | 88 |
| 42,6 | 42,6 | 44 | 44 | 11500 | 6500 | 24000 | 36000 | 60 | 273 | 613 | 174 | 820 | 1910 | 73 | 129 | 179 |
| 42,6 | 42,6 | 44 | 44 | 12100 | 6500 | 36000 | 56000 | 21 | 96 | 213 | 63 | 301 | 709 | 27 | 49 | 71 |
| 42,6 | 42,6 | 44 | 44 | 11500 | 6200 | 32000 | 50000 | 33 | 158 | 359 | 95 | 463 | 1081 | 67 | 117 | 161 |
| 42,6 | 41,2 | 43,4 | 43,4 | 6400 | 3800 | 36000 | 56000 | 23 | 70 | 140 | 70 | 220 | 459 | 25 | 39 | 53 |
| 42,6 | 41,2 | 43,4 | 43,4 | 6100 | 3600 | 32000 | 50000 | 38 | 113 | 226 | 109 | 333 | 680 | 61 | 91 | 119 |
| 42,6 | 41,2 | 43,4 | 43,4 | 6100 | 3450 | 40000 | 63000 | 26 | 78 | 155 | 74 | 226 | 459 | 61 | 89 | 116 |
| 41,7 | 39,6 | 43,3 | 43,3 | 9400 | 4550 | 36000 | 56000 | 48 | 127 | 267 | 141 | 384 | 841 | 33 | 48 | 66 |
| 41,7 | 39,6 | 43,3 | 43,3 | 9000 | 4350 | 34000 | 50000 | 69 | 180 | 376 | 198 | 526 | 1117 | 66 | 93 | 123 |
| 41,7 | 39,6 | 43,3 | 43,3 | 9500 | 4350 | 45000 | 67000 | 34 | 89 | 186 | 98 | 264 | 569 | 33 | 47 | 63 |

## 2.2.2 Spindle bearings

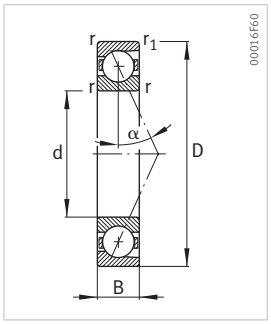
With large, medium or small balls

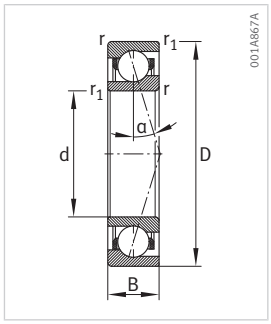
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

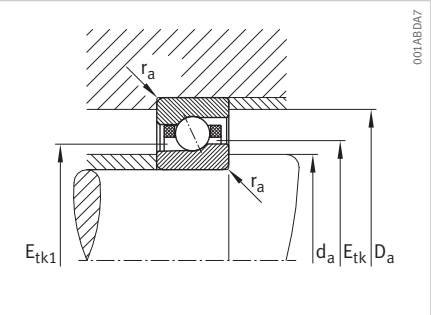
sealed



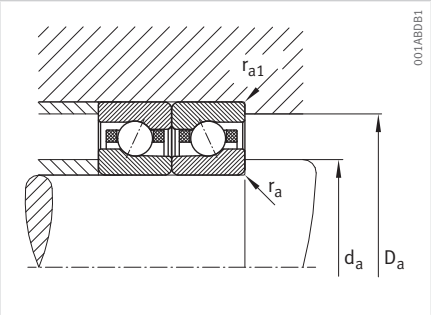




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCM71907-E-T-P4S-XL** | • | 0,061 | 35 | 55 | 10 | 0,6 | 0,3 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **VCM71907-C-T-P4S-XL** | • | 0,061 | 35 | 55 | 10 | 0,6 | 0,3 | 17 | 40 | 51,5 | 0,6 | 0,15 |
| **VCM71907-E-T-P4S-XL** | • | 0,061 | 35 | 55 | 10 | 0,6 | 0,3 | 25 | 40 | 51,5 | 0,6 | 0,15 |
| **B7007-C-T-P4S** | • | 0,154 | 35 | 62 | 14 | 1 | 1 | 15 | 41 | 56 | 1 | 0,3 |
| **B7007-E-T-P4S** | • | 0,154 | 35 | 62 | 14 | 1 | 1 | 25 | 41 | 56 | 1 | 0,3 |
| **HCB7007-C-T-P4S** | • | 0,135 | 35 | 62 | 14 | 1 | 1 | 15 | 41 | 56 | 1 | 0,3 |
| **HCB7007-E-T-P4S** | • | 0,135 | 35 | 62 | 14 | 1 | 1 | 25 | 41 | 56 | 1 | 0,3 |
| **HS7007-C-T-P4S** | • | 0,169 | 35 | 62 | 14 | 1 | 1 | 15 | 41 | 56 | 1 | 0,3 |
| **HS7007-E-T-P4S** | • | 0,169 | 35 | 62 | 14 | 1 | 1 | 25 | 41 | 56 | 1 | 0,3 |
| **HC7007-E-T-P4S** | • | 0,163 | 35 | 62 | 14 | 1 | 1 | 25 | 41 | 56 | 1 | 0,3 |
| **M7007-C-T-P4S-XL** | • | 0,15 | 35 | 62 | 14 | 1 | 0,6 | 17 | 41 | 56 | 1 | 0,3 |
| **M7007-E-T-P4S-XL** | • | 0,15 | 35 | 62 | 14 | 1 | 0,6 | 25 | 41 | 56 | 1 | 0,3 |
| **HCM7007-C-T-P4S-XL** | • | 0,14 | 35 | 62 | 14 | 1 | 0,6 | 17 | 41 | 56 | 1 | 0,3 |
| **HCM7007-E-T-P4S-XL** | • | 0,14 | 35 | 62 | 14 | 1 | 0,6 | 25 | 41 | 56 | 1 | 0,3 |
| **VCM7007-C-T-P4S-XL** | • | 0,14 | 35 | 62 | 14 | 1 | 0,6 | 17 | 41 | 56 | 1 | 0,3 |
| **VCM7007-E-T-P4S-XL** | • | 0,14 | 35 | 62 | 14 | 1 | 0,6 | 25 | 41 | 56 | 1 | 0,3 |
| **B7207-C-T-P4S** | • | 0,301 | 35 | 72 | 17 | 1,1 | 1,1 | 15 | 44 | 63 | 1 | 0,3 |
| **B7207-E-T-P4S** | • | 0,3 | 35 | 72 | 17 | 1,1 | 1,1 | 25 | 44 | 63 | 1 | 0,3 |
| **HCB7207-C-T-P4S** | • | 0,265 | 35 | 72 | 17 | 1,1 | 1,1 | 15 | 44 | 63 | 1 | 0,3 |
| **HCB7207-E-T-P4S** | • | 0,264 | 35 | 72 | 17 | 1,1 | 1,1 | 25 | 44 | 63 | 1 | 0,3 |
| **B71908-C-T-P4S** | • | 0,109 | 40 | 62 | 12 | 0,6 | 0,6 | 15 | 45 | 58,5 | 0,6 | 0,15 |
| **B71908-E-T-P4S** | • | 0,109 | 40 | 62 | 12 | 0,6 | 0,6 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **HCB71908-C-T-P4S** | • | 0,092 | 40 | 62 | 12 | 0,6 | 0,6 | 15 | 45 | 58,5 | 0,6 | 0,15 |
| **HCB71908-E-T-P4S** | • | 0,092 | 40 | 62 | 12 | 0,6 | 0,6 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **HS71908-C-T-P4S** | • | 0,125 | 40 | 62 | 12 | 0,6 | 0,6 | 15 | 45 | 58,5 | 0,6 | 0,15 |
| **HS71908-E-T-P4S** | • | 0,125 | 40 | 62 | 12 | 0,6 | 0,6 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **HC71908-E-T-P4S** | • | 0,119 | 40 | 62 | 12 | 0,6 | 0,6 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **M71908-C-T-P4S-XL** | • | 0,1 | 40 | 62 | 12 | 0,6 | 0,3 | 17 | 45 | 58,5 | 0,6 | 0,15 |
| **M71908-E-T-P4S-XL** | • | 0,1 | 40 | 62 | 12 | 0,6 | 0,3 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **HCM71908-C-T-P4S-XL** | • | 0,089 | 40 | 62 | 12 | 0,6 | 0,3 | 17 | 45 | 58,5 | 0,6 | 0,15 |
| **HCM71908-E-T-P4S-XL** | • | 0,089 | 40 | 62 | 12 | 0,6 | 0,3 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **VCM71908-C-T-P4S-XL** | • | 0,089 | 40 | 62 | 12 | 0,6 | 0,3 | 17 | 45 | 58,5 | 0,6 | 0,15 |
| **VCM71908-E-T-P4S-XL** | • | 0,089 | 40 | 62 | 12 | 0,6 | 0,3 | 25 | 45 | 58,5 | 0,6 | 0,15 |
| **B7008-C-T-P4S** | • | 0,189 | 40 | 68 | 15 | 1 | 1 | 15 | 46 | 62 | 1 | 0,3 |
| **B7008-E-T-P4S** | • | 0,189 | 40 | 68 | 15 | 1 | 1 | 25 | 46 | 62 | 1 | 0,3 |
| **HCB7008-C-T-P4S** | • | 0,166 | 40 | 68 | 15 | 1 | 1 | 15 | 46 | 62 | 1 | 0,3 |
| **HCB7008-E-T-P4S** | • | 0,166 | 40 | 68 | 15 | 1 | 1 | 25 | 46 | 62 | 1 | 0,3 |
| **HS7008-C-T-P4S** | • | 0,211 | 40 | 68 | 15 | 1 | 1 | 15 | 46 | 62 | 1 | 0,3 |
| **HS7008-E-T-P4S** | • | 0,211 | 40 | 68 | 15 | 1 | 1 | 25 | 46 | 62 | 1 | 0,3 |
| **HC7008-E-T-P4S** | • | 0,204 | 40 | 68 | 15 | 1 | 1 | 25 | 46 | 62 | 1 | 0,3 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 41,7 | 39,6 | 43,3 | 43,3 | 9000 | 4200 | 43000 | 63000 | 48 | 127 | 264 | 139 | 367 | 773 | 66 | 93 | 121 |
| 41,7 | 39,6 | 43,3 | 43,3 | 22700 | 6100 | 48000 | 75000 | 30 | 79 | 166 | 88 | 235 | 506 | 32 | 46 | 62 |
| 41,7 | 39,6 | 43,3 | 43,3 | 21700 | 5900 | 45000 | 67000 | 44 | 114 | 237 | 125 | 329 | 692 | 66 | 92 | 120 |
| 44,5 | 44,5 | 46,3 | 46,3 | 19300 | 9600 | 24000 | 38000 | 95 | 321 | 649 | 296 | 1087 | 2357 | 38 | 67 | 96 |
| 44,5 | 44,5 | 46,3 | 46,3 | 18400 | 9200 | 22000 | 34000 | 134 | 511 | 1097 | 394 | 1551 | 3446 | 88 | 146 | 200 |
| 44,5 | 44,5 | 46,3 | 46,3 | 19400 | 9200 | 34000 | 53000 | 46 | 175 | 372 | 138 | 558 | 1255 | 32 | 56 | 79 |
| 44,5 | 44,5 | 46,3 | 46,3 | 18500 | 8800 | 30000 | 45000 | 54 | 257 | 585 | 157 | 761 | 1771 | 72 | 126 | 173 |
| 45,7 | 43,9 | 46,8 | 46,8 | 8900 | 5000 | 34000 | 50000 | 31 | 93 | 187 | 94 | 295 | 614 | 27 | 43 | 59 |
| 45,7 | 43,9 | 46,8 | 46,8 | 8400 | 4700 | 30000 | 45000 | 51 | 152 | 304 | 146 | 448 | 915 | 68 | 101 | 132 |
| 45,7 | 43,9 | 46,8 | 46,8 | 8400 | 4500 | 38000 | 60000 | 35 | 105 | 210 | 101 | 307 | 623 | 67 | 100 | 129 |
| 44,7 | 42,3 | 46,6 | 46,6 | 11300 | 5300 | 34000 | 53000 | 56 | 148 | 311 | 164 | 448 | 979 | 34 | 49 | 67 |
| 44,7 | 42,3 | 46,6 | 46,6 | 10800 | 5000 | 32000 | 48000 | 80 | 210 | 438 | 230 | 613 | 1302 | 68 | 96 | 126 |
| 44,7 | 42,3 | 46,6 | 46,6 | 11300 | 5000 | 43000 | 63000 | 39 | 103 | 217 | 114 | 307 | 663 | 33 | 48 | 64 |
| 44,7 | 42,3 | 46,6 | 46,6 | 10800 | 4850 | 40000 | 56000 | 57 | 148 | 308 | 162 | 428 | 901 | 68 | 95 | 124 |
| 44,7 | 42,3 | 46,6 | 46,6 | 27000 | 7100 | 43000 | 67000 | 35 | 93 | 194 | 102 | 274 | 589 | 33 | 47 | 63 |
| 44,7 | 42,3 | 46,6 | 46,6 | 26000 | 6800 | 40000 | 63000 | 51 | 133 | 276 | 145 | 383 | 806 | 68 | 95 | 123 |
| 47,8 | 47,8 | 51 | 51 | 25500 | 12600 | 20000 | 34000 | 134 | 443 | 887 | 418 | 1500 | 3223 | 45 | 78 | 112 |
| 47,8 | 47,8 | 51 | 51 | 24500 | 12100 | 19000 | 32000 | 195 | 710 | 1504 | 570 | 2152 | 4730 | 103 | 169 | 232 |
| 47,8 | 47,8 | 51 | 51 | 25500 | 12100 | 26000 | 40000 | 67 | 243 | 510 | 200 | 774 | 1720 | 38 | 65 | 92 |
| 47,8 | 47,8 | 51 | 51 | 24600 | 11600 | 22000 | 36000 | 84 | 363 | 806 | 242 | 1069 | 2438 | 86 | 146 | 200 |
| 47,3 | 47,3 | 49,1 | 49,1 | 18000 | 9900 | 24000 | 36000 | 84 | 292 | 594 | 259 | 979 | 2140 | 41 | 72 | 103 |
| 47,3 | 47,3 | 49,1 | 49,1 | 17100 | 9400 | 20000 | 32000 | 111 | 447 | 974 | 324 | 1348 | 3043 | 91 | 155 | 213 |
| 47,3 | 47,3 | 49,1 | 49,1 | 18100 | 9400 | 32000 | 50000 | 39 | 156 | 337 | 116 | 494 | 1127 | 34 | 59 | 85 |
| 47,3 | 47,3 | 49,1 | 49,1 | 17200 | 9000 | 28000 | 45000 | 41 | 220 | 514 | 117 | 645 | 1548 | 72 | 132 | 183 |
| 48,6 | 47,2 | 49,3 | 49,3 | 6800 | 4300 | 32000 | 48000 | 24 | 72 | 145 | 72 | 227 | 473 | 27 | 42 | 57 |
| 48,6 | 47,2 | 49,3 | 49,3 | 6400 | 4050 | 28000 | 43000 | 39 | 117 | 235 | 113 | 345 | 704 | 67 | 99 | 129 |
| 48,6 | 47,2 | 49,3 | 49,3 | 6400 | 3900 | 36000 | 56000 | 27 | 82 | 164 | 78 | 238 | 484 | 66 | 98 | 127 |
| 47,2 | 44,8 | 49,1 | 49,1 | 11600 | 5600 | 32000 | 50000 | 59 | 157 | 331 | 174 | 477 | 1044 | 36 | 52 | 71 |
| 47,2 | 44,8 | 49,1 | 49,1 | 11100 | 5400 | 30000 | 45000 | 85 | 224 | 466 | 245 | 653 | 1386 | 72 | 101 | 134 |
| 47,2 | 44,8 | 49,1 | 49,1 | 11600 | 5400 | 40000 | 60000 | 42 | 110 | 231 | 121 | 327 | 706 | 35 | 51 | 68 |
| 47,2 | 44,8 | 49,1 | 49,1 | 11100 | 5100 | 38000 | 56000 | 60 | 157 | 327 | 172 | 456 | 960 | 72 | 101 | 132 |
| 47,2 | 44,8 | 49,1 | 49,1 | 28000 | 7500 | 40000 | 63000 | 37 | 99 | 207 | 109 | 292 | 628 | 35 | 50 | 67 |
| 47,2 | 44,8 | 49,1 | 49,1 | 26500 | 7200 | 40000 | 60000 | 54 | 141 | 294 | 155 | 408 | 858 | 72 | 100 | 131 |
| 49,3 | 49,3 | 51,8 | 51,8 | 20900 | 11200 | 22000 | 34000 | 101 | 344 | 698 | 312 | 1157 | 2515 | 43 | 76 | 109 |
| 49,3 | 49,3 | 51,8 | 51,8 | 19900 | 10600 | 20000 | 30000 | 141 | 543 | 1170 | 410 | 1640 | 3663 | 99 | 165 | 227 |
| 49,3 | 49,3 | 51,8 | 51,8 | 20900 | 10700 | 30000 | 45000 | 49 | 188 | 402 | 146 | 597 | 1350 | 36 | 63 | 90 |
| 49,3 | 49,3 | 51,8 | 51,8 | 19900 | 10200 | 28000 | 43000 | 55 | 271 | 622 | 159 | 797 | 1875 | 80 | 142 | 195 |
| 51,2 | 49,4 | 52,3 | 52,3 | 9400 | 5700 | 30000 | 45000 | 34 | 101 | 201 | 100 | 316 | 659 | 30 | 47 | 65 |
| 51,2 | 49,4 | 52,3 | 52,3 | 8900 | 5400 | 26000 | 40000 | 53 | 160 | 321 | 154 | 472 | 964 | 75 | 111 | 145 |
| 51,2 | 49,4 | 52,3 | 52,3 | 8900 | 5200 | 34000 | 53000 | 37 | 110 | 221 | 106 | 321 | 652 | 74 | 110 | 142 |

## 2.2.2 Spindle bearings

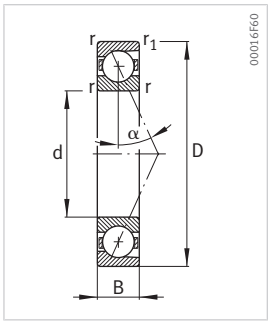
With large, medium or small balls

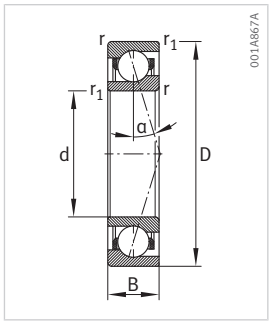
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

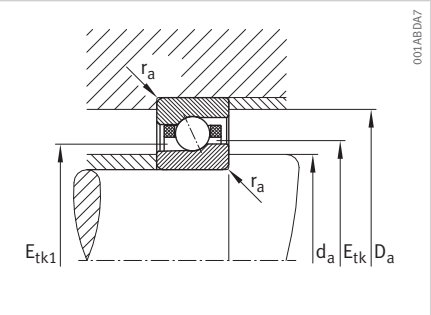
sealed



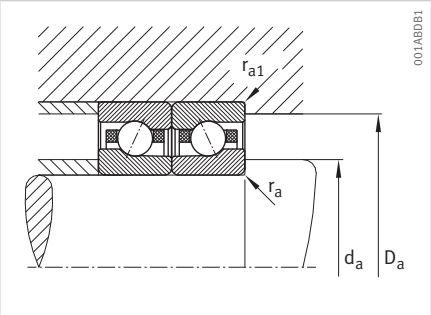




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **M7008-C-T-P4S-XL** | • | 0,19 | 40 | 68 | 15 | 1 | 0,6 | 17 | 46 | 62 | 1 | 0,3 |
| **M7008-E-T-P4S-XL** | • | 0,19 | 40 | 68 | 15 | 1 | 0,6 | 25 | 46 | 62 | 1 | 0,3 |
| **HCM7008-C-T-P4S-XL** | • | 0,18 | 40 | 68 | 15 | 1 | 0,6 | 17 | 46 | 62 | 1 | 0,3 |
| **HCM7008-E-T-P4S-XL** | • | 0,18 | 40 | 68 | 15 | 1 | 0,6 | 25 | 46 | 62 | 1 | 0,3 |
| **VCM7008-C-T-P4S-XL** | • | 0,18 | 40 | 68 | 15 | 1 | 0,6 | 17 | 46 | 62 | 1 | 0,3 |
| **VCM7008-E-T-P4S-XL** | • | 0,18 | 40 | 68 | 15 | 1 | 0,6 | 25 | 46 | 62 | 1 | 0,3 |
| **B7208-C-T-P4S** | • | 0,372 | 40 | 80 | 18 | 1,1 | 1,1 | 15 | 48 | 72 | 1 | 0,6 |
| **B7208-E-T-P4S** | • | 0,371 | 40 | 80 | 18 | 1,1 | 1,1 | 25 | 48 | 72 | 1 | 0,6 |
| **HCB7208-C-T-P4S** | • | 0,322 | 40 | 80 | 18 | 1,1 | 1,1 | 15 | 48 | 72 | 1 | 0,6 |
| **HCB7208-E-T-P4S** | • | 0,321 | 40 | 80 | 18 | 1,1 | 1,1 | 25 | 48 | 72 | 1 | 0,6 |
| **B71909-C-T-P4S** | • | 0,127 | 45 | 68 | 12 | 0,6 | 0,6 | 15 | 50 | 63,5 | 0,6 | 0,15 |
| **B71909-E-T-P4S** | • | 0,127 | 45 | 68 | 12 | 0,6 | 0,6 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **HCB71909-C-T-P4S** | • | 0,108 | 45 | 68 | 12 | 0,6 | 0,6 | 15 | 50 | 63,5 | 0,6 | 0,15 |
| **HCB71909-E-T-P4S** | • | 0,108 | 45 | 68 | 12 | 0,6 | 0,6 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **HS71909-C-T-P4S** | • | 0,136 | 45 | 68 | 12 | 0,6 | 0,6 | 15 | 50 | 63,5 | 0,6 | 0,15 |
| **HS71909-E-T-P4S** | • | 0,136 | 45 | 68 | 12 | 0,6 | 0,6 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **HC71909-E-T-P4S** | • | 0,129 | 45 | 68 | 12 | 0,6 | 0,6 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **M71909-C-T-P4S-XL** | • | 0,12 | 45 | 68 | 12 | 0,6 | 0,3 | 17 | 50 | 63,5 | 0,6 | 0,15 |
| **M71909-E-T-P4S-XL** | • | 0,12 | 45 | 68 | 12 | 0,6 | 0,3 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **HCM71909-C-T-P4S-XL** | • | 0,11 | 45 | 68 | 12 | 0,6 | 0,3 | 17 | 50 | 63,5 | 0,6 | 0,15 |
| **HCM71909-E-T-P4S-XL** | • | 0,11 | 45 | 68 | 12 | 0,6 | 0,3 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **VCM71909-C-T-P4S-XL** | • | 0,11 | 45 | 68 | 12 | 0,6 | 0,3 | 17 | 50 | 63,5 | 0,6 | 0,15 |
| **VCM71909-E-T-P4S-XL** | • | 0,11 | 45 | 68 | 12 | 0,6 | 0,3 | 25 | 50 | 63,5 | 0,6 | 0,15 |
| **B7009-C-T-P4S** | • | 0,232 | 45 | 75 | 16 | 1 | 1 | 15 | 51 | 69 | 1 | 0,3 |
| **B7009-E-T-P4S** | • | 0,232 | 45 | 75 | 16 | 1 | 1 | 25 | 51 | 69 | 1 | 0,3 |
| **HCB7009-C-T-P4S** | • | 0,191 | 45 | 75 | 16 | 1 | 1 | 15 | 51 | 69 | 1 | 0,3 |
| **HCB7009-E-T-P4S** | • | 0,191 | 45 | 75 | 16 | 1 | 1 | 25 | 51 | 69 | 1 | 0,3 |
| **HS7009-C-T-P4S** | • | 0,262 | 45 | 75 | 16 | 1 | 1 | 15 | 51 | 69 | 1 | 0,3 |
| **HS7009-E-T-P4S** | • | 0,261 | 45 | 75 | 16 | 1 | 1 | 25 | 51 | 69 | 1 | 0,3 |
| **HC7009-E-T-P4S** | • | 0,248 | 45 | 75 | 16 | 1 | 1 | 25 | 51 | 69 | 1 | 0,3 |
| **M7009-C-T-P4S-XL** | • | 0,25 | 45 | 75 | 16 | 1 | 0,6 | 17 | 51 | 69 | 1 | 0,3 |
| **M7009-E-T-P4S-XL** | • | 0,25 | 45 | 75 | 16 | 1 | 0,6 | 25 | 51 | 69 | 1 | 0,3 |
| **HCM7009-C-T-P4S-XL** | • | 0,23 | 45 | 75 | 16 | 1 | 0,6 | 17 | 51 | 69 | 1 | 0,3 |
| **HCM7009-E-T-P4S-XL** | • | 0,23 | 45 | 75 | 16 | 1 | 0,6 | 25 | 51 | 69 | 1 | 0,3 |
| **VCM7009-C-T-P4S-XL** | • | 0,23 | 45 | 75 | 16 | 1 | 0,6 | 17 | 51 | 69 | 1 | 0,3 |
| **VCM7009-E-T-P4S-XL** | • | 0,23 | 45 | 75 | 16 | 1 | 0,6 | 25 | 51 | 69 | 1 | 0,3 |
| **B7209-C-T-P4S** | • | 0,423 | 45 | 85 | 19 | 1,1 | 1,1 | 15 | 52,5 | 78 | 1 | 0,6 |
| **B7209-E-T-P4S** | • | 0,422 | 45 | 85 | 19 | 1,1 | 1,1 | 25 | 52,5 | 78 | 1 | 0,6 |
| **HCB7209-C-T-P4S** | • | 0,37 | 45 | 85 | 19 | 1,1 | 1,1 | 15 | 52,5 | 78 | 1 | 0,6 |
| **HCB7209-E-T-P4S** | • | 0,369 | 45 | 85 | 19 | 1,1 | 1,1 | 25 | 52,5 | 78 | 1 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 50,2 | 47,8 | 52,1 | 52,1 | 11900 | 6000 | 30000 | 45000 | 63 | 167 | 352 | 185 | 507 | 1110 | 38 | 55 | 76 |
| 50,2 | 47,8 | 52,1 | 52,1 | 11400 | 5700 | 28000 | 43000 | 91 | 238 | 495 | 261 | 694 | 1473 | 76 | 107 | 141 |
| 50,2 | 47,8 | 52,1 | 52,1 | 11900 | 5700 | 38000 | 56000 | 44 | 117 | 245 | 129 | 348 | 751 | 37 | 54 | 72 |
| 50,2 | 47,8 | 52,1 | 52,1 | 11400 | 5500 | 36000 | 53000 | 64 | 167 | 348 | 183 | 484 | 1020 | 76 | 107 | 139 |
| 50,2 | 47,8 | 52,1 | 52,1 | 28500 | 8000 | 38000 | 60000 | 40 | 105 | 220 | 116 | 311 | 668 | 37 | 53 | 71 |
| 50,2 | 47,8 | 52,1 | 52,1 | 27500 | 7700 | 38000 | 56000 | 57 | 150 | 312 | 164 | 434 | 912 | 76 | 106 | 138 |
| 53,4 | 53,4 | 57,2 | 57,2 | 32500 | 16100 | 18000 | 30000 | 175 | 566 | 1128 | 544 | 1920 | 4102 | 49 | 85 | 122 |
| 53,4 | 53,4 | 57,2 | 57,2 | 31000 | 15400 | 17000 | 28000 | 257 | 906 | 1903 | 750 | 2748 | 5985 | 114 | 184 | 252 |
| 53,4 | 53,4 | 57,2 | 57,2 | 32500 | 15400 | 24000 | 38000 | 89 | 312 | 650 | 266 | 996 | 2193 | 42 | 71 | 100 |
| 53,4 | 53,4 | 57,2 | 57,2 | 31000 | 14700 | 20000 | 34000 | 121 | 485 | 1059 | 347 | 1432 | 3208 | 98 | 162 | 220 |
| 52,3 | 52,3 | 54,5 | 54,5 | 19100 | 11200 | 20000 | 32000 | 88 | 307 | 628 | 270 | 1027 | 2251 | 44 | 78 | 112 |
| 52,3 | 52,3 | 54,5 | 54,5 | 18200 | 10600 | 19000 | 28000 | 116 | 470 | 1028 | 336 | 1415 | 3203 | 99 | 168 | 232 |
| 52,3 | 52,3 | 54,5 | 54,5 | 19200 | 10700 | 28000 | 45000 | 40 | 164 | 355 | 120 | 516 | 1182 | 36 | 64 | 92 |
| 52,3 | 52,3 | 54,5 | 54,5 | 18200 | 10200 | 26000 | 40000 | 42 | 233 | 547 | 121 | 682 | 1643 | 79 | 144 | 200 |
| 53,7 | 51,9 | 54,7 | 54,7 | 9600 | 6000 | 28000 | 43000 | 34 | 101 | 201 | 100 | 316 | 657 | 31 | 48 | 66 |
| 53,7 | 51,9 | 54,7 | 54,7 | 9100 | 5600 | 26000 | 40000 | 55 | 164 | 328 | 158 | 482 | 984 | 77 | 115 | 150 |
| 53,7 | 51,9 | 54,7 | 54,7 | 9100 | 5400 | 32000 | 50000 | 38 | 113 | 226 | 108 | 329 | 667 | 77 | 113 | 146 |
| 52,7 | 50,3 | 54,6 | 54,6 | 12200 | 6300 | 30000 | 45000 | 67 | 177 | 372 | 196 | 537 | 1175 | 40 | 58 | 80 |
| 52,7 | 50,3 | 54,6 | 54,6 | 11700 | 6000 | 28000 | 40000 | 96 | 251 | 524 | 276 | 734 | 1558 | 80 | 113 | 149 |
| 52,7 | 50,3 | 54,6 | 54,6 | 12300 | 6000 | 36000 | 53000 | 47 | 124 | 260 | 136 | 368 | 795 | 39 | 57 | 76 |
| 52,7 | 50,3 | 54,6 | 54,6 | 11700 | 5800 | 34000 | 50000 | 68 | 177 | 368 | 194 | 512 | 1078 | 80 | 112 | 146 |
| 52,7 | 50,3 | 54,6 | 54,6 | 29500 | 8500 | 38000 | 60000 | 42 | 111 | 232 | 122 | 329 | 707 | 39 | 56 | 75 |
| 52,7 | 50,3 | 54,6 | 54,6 | 28000 | 8100 | 36000 | 53000 | 61 | 159 | 330 | 174 | 459 | 964 | 80 | 111 | 145 |
| 54,3 | 54,3 | 57,3 | 57,3 | 28000 | 14900 | 19000 | 30000 | 144 | 476 | 958 | 445 | 1606 | 3461 | 50 | 86 | 124 |
| 54,3 | 54,3 | 57,3 | 57,3 | 26500 | 14200 | 17000 | 26000 | 208 | 763 | 1622 | 606 | 2308 | 5082 | 115 | 189 | 259 |
| 54,3 | 54,3 | 57,3 | 57,3 | 28000 | 14300 | 26000 | 40000 | 71 | 261 | 549 | 212 | 827 | 1843 | 42 | 72 | 102 |
| 54,3 | 54,3 | 57,3 | 57,3 | 26500 | 13600 | 24000 | 38000 | 89 | 389 | 869 | 254 | 1145 | 2622 | 96 | 163 | 223 |
| 56,7 | 54,6 | 58,2 | 58,2 | 12300 | 7500 | 26000 | 40000 | 43 | 130 | 259 | 130 | 409 | 853 | 34 | 54 | 74 |
| 56,7 | 54,6 | 58,2 | 58,2 | 11600 | 7100 | 24000 | 36000 | 70 | 210 | 421 | 203 | 621 | 1269 | 85 | 128 | 167 |
| 56,7 | 54,6 | 58,2 | 58,2 | 11600 | 6800 | 30000 | 48000 | 48 | 143 | 286 | 137 | 417 | 848 | 84 | 125 | 161 |
| 57,2 | 54,8 | 59 | 59 | 12800 | 7000 | 28000 | 40000 | 74 | 196 | 413 | 217 | 595 | 1303 | 44 | 64 | 88 |
| 57,2 | 54,8 | 59 | 59 | 12200 | 6700 | 26000 | 38000 | 106 | 278 | 580 | 305 | 812 | 1726 | 88 | 124 | 164 |
| 57,2 | 54,8 | 59 | 59 | 12900 | 6700 | 34000 | 50000 | 52 | 137 | 288 | 151 | 408 | 881 | 43 | 62 | 84 |
| 57,2 | 54,8 | 59 | 59 | 12300 | 6400 | 32000 | 45000 | 75 | 196 | 407 | 214 | 567 | 1194 | 88 | 123 | 161 |
| 57,2 | 54,8 | 59 | 59 | 31000 | 9400 | 34000 | 53000 | 47 | 123 | 258 | 135 | 364 | 784 | 43 | 62 | 82 |
| 57,2 | 54,8 | 59 | 59 | 29500 | 9000 | 32000 | 50000 | 67 | 176 | 365 | 192 | 508 | 1068 | 88 | 123 | 160 |
| 58,5 | 58,5 | 62,2 | 62,2 | 34000 | 17700 | 17000 | 28000 | 182 | 592 | 1182 | 567 | 2003 | 4286 | 52 | 90 | 129 |
| 58,5 | 58,5 | 62,2 | 62,2 | 32500 | 16900 | 15000 | 24000 | 268 | 948 | 1994 | 782 | 2873 | 6261 | 121 | 196 | 268 |
| 58,5 | 58,5 | 62,2 | 62,2 | 34500 | 17000 | 22000 | 36000 | 93 | 329 | 685 | 279 | 1047 | 2307 | 44 | 75 | 106 |
| 58,5 | 58,5 | 62,2 | 62,2 | 32500 | 16200 | 18000 | 30000 | 123 | 500 | 1095 | 354 | 1475 | 3312 | 103 | 172 | 233 |

## 2.2.2 Spindle bearings

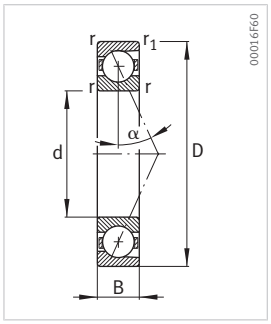
With large, medium or small balls

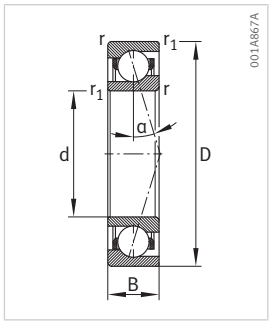
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

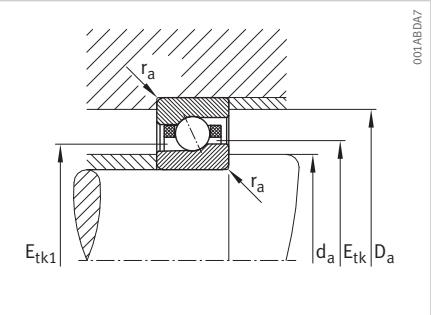
sealed



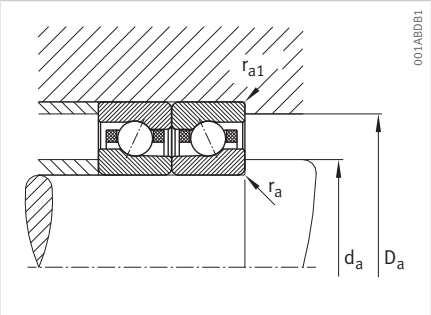




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B71910-C-T-P4S** | • | 0,128 | 50 | 72 | 12 | 0,6 | 0,6 | 15 | 55 | 67,5 | 0,6 | 0,15 |
| **B71910-E-T-P4S** | • | 0,128 | 50 | 72 | 12 | 0,6 | 0,6 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **HCB71910-C-T-P4S** | • | 0,109 | 50 | 72 | 12 | 0,6 | 0,6 | 15 | 55 | 67,5 | 0,6 | 0,15 |
| **HCB71910-E-T-P4S** | • | 0,109 | 50 | 72 | 12 | 0,6 | 0,6 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **HS71910-C-T-P4S** | • | 0,138 | 50 | 72 | 12 | 0,6 | 0,6 | 15 | 55 | 67,5 | 0,6 | 0,15 |
| **HS71910-E-T-P4S** | • | 0,138 | 50 | 72 | 12 | 0,6 | 0,6 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **HC71910-E-T-P4S** | • | 0,131 | 50 | 72 | 12 | 0,6 | 0,6 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **M71910-C-T-P4S-XL** | • | 0,12 | 50 | 72 | 12 | 0,6 | 0,3 | 17 | 55 | 67,5 | 0,6 | 0,15 |
| **M71910-E-T-P4S-XL** | • | 0,12 | 50 | 72 | 12 | 0,6 | 0,3 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **HCM71910-C-T-P4S-XL** | • | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 17 | 55 | 67,5 | 0,6 | 0,15 |
| **HCM71910-E-T-P4S-XL** | • | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **VCM71910-C-T-P4S-XL** | • | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 17 | 55 | 67,5 | 0,6 | 0,15 |
| **VCM71910-E-T-P4S-XL** | • | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 25 | 55 | 67,5 | 0,6 | 0,15 |
| **B7010-C-T-P4S** | • | 0,25 | 50 | 80 | 16 | 1 | 1 | 15 | 56 | 74 | 1 | 0,3 |
| **B7010-E-T-P4S** | • | 0,25 | 50 | 80 | 16 | 1 | 1 | 25 | 56 | 74 | 1 | 0,3 |
| **HCB7010-C-T-P4S** | • | 0,213 | 50 | 80 | 16 | 1 | 1 | 15 | 56 | 74 | 1 | 0,3 |
| **HCB7010-E-T-P4S** | • | 0,213 | 50 | 80 | 16 | 1 | 1 | 25 | 56 | 74 | 1 | 0,3 |
| **HS7010-C-T-P4S** | • | 0,283 | 50 | 80 | 16 | 1 | 1 | 15 | 56 | 74 | 1 | 0,3 |
| **HS7010-E-T-P4S** | • | 0,282 | 50 | 80 | 16 | 1 | 1 | 25 | 56 | 74 | 1 | 0,3 |
| **HC7010-E-T-P4S** | • | 0,269 | 50 | 80 | 16 | 1 | 1 | 25 | 56 | 74 | 1 | 0,3 |
| **M7010-C-T-P4S-XL** | • | 0,27 | 50 | 80 | 16 | 1 | 0,6 | 17 | 56 | 74 | 1 | 0,3 |
| **M7010-E-T-P4S-XL** | • | 0,27 | 50 | 80 | 16 | 1 | 0,6 | 25 | 56 | 74 | 1 | 0,3 |
| **HCM7010-C-T-P4S-XL** | • | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 17 | 56 | 74 | 1 | 0,3 |
| **HCM7010-E-T-P4S-XL** | • | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 25 | 56 | 74 | 1 | 0,3 |
| **VCM7010-C-T-P4S-XL** | • | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 17 | 56 | 74 | 1 | 0,3 |
| **VCM7010-E-T-P4S-XL** | • | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 25 | 56 | 74 | 1 | 0,3 |
| **B7210-C-T-P4S** | • | 0,448 | 50 | 90 | 20 | 1,1 | 1,1 | 15 | 57 | 83 | 1 | 0,6 |
| **B7210-E-T-P4S** | • | 0,446 | 50 | 90 | 20 | 1,1 | 1,1 | 25 | 57 | 83 | 1 | 0,6 |
| **HCB7210-C-T-P4S** | • | 0,384 | 50 | 90 | 20 | 1,1 | 1,1 | 15 | 57 | 83 | 1 | 0,6 |
| **HCB7210-E-T-P4S** | • | 0,382 | 50 | 90 | 20 | 1,1 | 1,1 | 25 | 57 | 83 | 1 | 0,6 |
| **B71911-C-T-P4S** | • | 0,174 | 55 | 80 | 13 | 1 | 1 | 15 | 60 | 75,5 | 0,6 | 0,3 |
| **B71911-E-T-P4S** | • | 0,174 | 55 | 80 | 13 | 1 | 1 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **HCB71911-C-T-P4S** | • | 0,148 | 55 | 80 | 13 | 1 | 1 | 15 | 60 | 75,5 | 0,6 | 0,3 |
| **HCB71911-E-T-P4S** | • | 0,148 | 55 | 80 | 13 | 1 | 1 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **HS71911-C-T-P4S** | • | 0,186 | 55 | 80 | 13 | 1 | 1 | 15 | 60 | 75,5 | 0,6 | 0,3 |
| **HS71911-E-T-P4S** | • | 0,186 | 55 | 80 | 13 | 1 | 1 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **HC71911-E-T-P4S** | • | 0,172 | 55 | 80 | 13 | 1 | 1 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **M71911-C-T-P4S-XL** | • | 0,16 | 55 | 80 | 13 | 1 | 0,6 | 17 | 60 | 75,5 | 0,6 | 0,3 |
| **M71911-E-T-P4S-XL** | • | 0,16 | 55 | 80 | 13 | 1 | 0,6 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **HCM71911-C-T-P4S-XL** | • | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 17 | 60 | 75,5 | 0,6 | 0,3 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 56,8 | 56,8 | 58,9 | 58,9 | 19600 | 11900 | 19000 | 30000 | 89 | 313 | 642 | 274 | 1044 | 2293 | 46 | 80 | 116 |
| 56,8 | 56,8 | 58,9 | 58,9 | 18600 | 11300 | 17000 | 26000 | 117 | 479 | 1049 | 340 | 1439 | 3263 | 103 | 174 | 241 |
| 56,8 | 56,8 | 58,9 | 58,9 | 19600 | 11400 | 26000 | 40000 | 41 | 167 | 362 | 121 | 525 | 1205 | 38 | 66 | 95 |
| 56,8 | 56,8 | 58,9 | 58,9 | 18600 | 10800 | 24000 | 36000 | 40 | 229 | 542 | 115 | 671 | 1626 | 80 | 148 | 205 |
| 58,2 | 56,4 | 59,1 | 59,1 | 9900 | 6500 | 26000 | 40000 | 35 | 105 | 209 | 104 | 328 | 682 | 33 | 51 | 70 |
| 58,2 | 56,4 | 59,1 | 59,1 | 9400 | 6100 | 24000 | 36000 | 56 | 169 | 338 | 163 | 497 | 1014 | 82 | 122 | 159 |
| 58,2 | 56,4 | 59,1 | 59,1 | 9400 | 5800 | 30000 | 48000 | 39 | 116 | 231 | 110 | 336 | 682 | 81 | 119 | 154 |
| 57,2 | 54,8 | 58,9 | 58,9 | 12800 | 7000 | 28000 | 40000 | 74 | 196 | 413 | 217 | 595 | 1303 | 44 | 64 | 88 |
| 57,2 | 54,8 | 58,9 | 58,9 | 12200 | 6700 | 26000 | 38000 | 106 | 278 | 580 | 305 | 812 | 1726 | 88 | 124 | 164 |
| 57,2 | 54,8 | 58,9 | 58,9 | 12900 | 6700 | 34000 | 50000 | 52 | 137 | 288 | 151 | 408 | 881 | 43 | 62 | 84 |
| 57,2 | 54,8 | 58,9 | 58,9 | 12300 | 6400 | 32000 | 45000 | 75 | 196 | 407 | 214 | 567 | 1194 | 88 | 123 | 161 |
| 57,2 | 54,8 | 58,9 | 58,9 | 31000 | 9400 | 34000 | 53000 | 47 | 123 | 258 | 135 | 364 | 784 | 43 | 62 | 82 |
| 57,2 | 54,8 | 58,9 | 58,9 | 29500 | 9000 | 32000 | 50000 | 67 | 176 | 365 | 192 | 508 | 1068 | 88 | 123 | 160 |
| 59,3 | 59,3 | 62,3 | 62,3 | 29000 | 16100 | 18000 | 28000 | 148 | 493 | 994 | 459 | 1659 | 3579 | 52 | 91 | 130 |
| 59,3 | 59,3 | 62,3 | 62,3 | 27500 | 15300 | 16000 | 24000 | 209 | 774 | 1648 | 610 | 2336 | 5151 | 120 | 197 | 270 |
| 59,3 | 59,3 | 62,3 | 62,3 | 29000 | 15400 | 24000 | 38000 | 73 | 268 | 566 | 217 | 848 | 1894 | 44 | 75 | 107 |
| 59,3 | 59,3 | 62,3 | 62,3 | 27500 | 14700 | 22000 | 34000 | 90 | 400 | 895 | 259 | 1175 | 2697 | 100 | 171 | 234 |
| 61,7 | 59,6 | 63 | 63 | 12800 | 8200 | 24000 | 38000 | 45 | 135 | 269 | 135 | 424 | 884 | 36 | 57 | 79 |
| 61,7 | 59,6 | 63 | 63 | 12100 | 7700 | 22000 | 34000 | 72 | 216 | 431 | 208 | 635 | 1297 | 91 | 135 | 176 |
| 61,7 | 59,6 | 63 | 63 | 12100 | 7400 | 28000 | 43000 | 50 | 149 | 298 | 143 | 435 | 883 | 90 | 133 | 172 |
| 61,2 | 58,8 | 63 | 63 | 13100 | 7400 | 26000 | 38000 | 78 | 206 | 435 | 229 | 627 | 1373 | 46 | 67 | 92 |
| 61,2 | 58,8 | 63 | 63 | 12400 | 7000 | 24000 | 36000 | 112 | 293 | 610 | 321 | 855 | 1816 | 92 | 130 | 171 |
| 61,2 | 58,8 | 63 | 63 | 13100 | 7100 | 32000 | 45000 | 55 | 144 | 303 | 159 | 430 | 928 | 45 | 65 | 88 |
| 61,2 | 58,8 | 63 | 63 | 12500 | 6700 | 30000 | 43000 | 79 | 206 | 429 | 225 | 596 | 1257 | 92 | 129 | 169 |
| 61,2 | 58,8 | 63 | 63 | 31500 | 9900 | 32000 | 50000 | 49 | 129 | 271 | 143 | 384 | 825 | 45 | 64 | 86 |
| 61,2 | 58,8 | 63 | 63 | 30000 | 9400 | 30000 | 45000 | 71 | 185 | 385 | 202 | 534 | 1124 | 92 | 128 | 167 |
| 62,4 | 62,4 | 66,8 | 66,8 | 43000 | 22400 | 16000 | 26000 | 240 | 771 | 1534 | 746 | 2606 | 5556 | 60 | 103 | 147 |
| 62,4 | 62,4 | 66,8 | 66,8 | 41000 | 21400 | 14000 | 22000 | 352 | 1221 | 2553 | 1027 | 3697 | 8006 | 138 | 223 | 303 |
| 62,4 | 62,4 | 66,8 | 66,8 | 43000 | 21400 | 20000 | 34000 | 126 | 434 | 898 | 377 | 1383 | 3027 | 51 | 87 | 122 |
| 62,4 | 62,4 | 66,8 | 66,8 | 41500 | 20400 | 17000 | 28000 | 168 | 656 | 1420 | 484 | 1933 | 4292 | 120 | 197 | 265 |
| 62,8 | 62,8 | 65,1 | 65,1 | 23500 | 14400 | 17000 | 26000 | 111 | 382 | 780 | 340 | 1274 | 2784 | 51 | 89 | 128 |
| 62,8 | 62,8 | 65,1 | 65,1 | 22200 | 13700 | 15000 | 24000 | 149 | 588 | 1278 | 431 | 1768 | 3973 | 115 | 193 | 266 |
| 62,8 | 62,8 | 65,1 | 65,1 | 23500 | 13800 | 24000 | 36000 | 53 | 208 | 447 | 157 | 654 | 1487 | 42 | 74 | 106 |
| 62,8 | 62,8 | 65,1 | 65,1 | 22300 | 13100 | 22000 | 32000 | 57 | 296 | 686 | 164 | 867 | 2058 | 93 | 167 | 230 |
| 64,2 | 62,1 | 65,4 | 65,4 | 13000 | 8500 | 24000 | 36000 | 45 | 135 | 269 | 135 | 424 | 882 | 37 | 59 | 80 |
| 64,2 | 62,1 | 65,4 | 65,4 | 12300 | 8000 | 22000 | 32000 | 73 | 219 | 438 | 211 | 645 | 1317 | 93 | 139 | 181 |
| 64,2 | 62,1 | 65,4 | 65,4 | 12300 | 7700 | 28000 | 43000 | 51 | 152 | 304 | 145 | 442 | 897 | 93 | 137 | 177 |
| 62,7 | 59,7 | 65,1 | 65,1 | 18500 | 9900 | 24000 | 38000 | 104 | 276 | 583 | 307 | 840 | 1838 | 50 | 73 | 100 |
| 62,7 | 59,7 | 65,1 | 65,1 | 17700 | 9500 | 22000 | 34000 | 150 | 393 | 820 | 431 | 1148 | 2438 | 100 | 141 | 186 |
| 62,7 | 59,7 | 65,1 | 65,1 | 18500 | 9500 | 30000 | 45000 | 73 | 194 | 406 | 213 | 576 | 1243 | 49 | 71 | 95 |

## 2.2.2 Spindle bearings

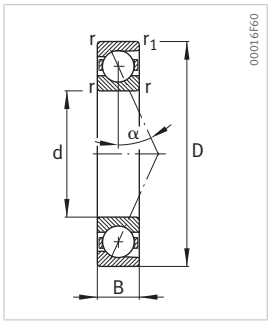
With large, medium or small balls

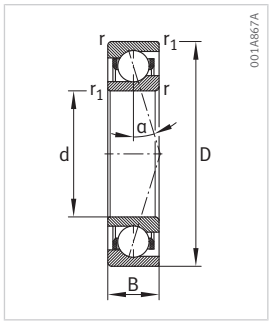
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

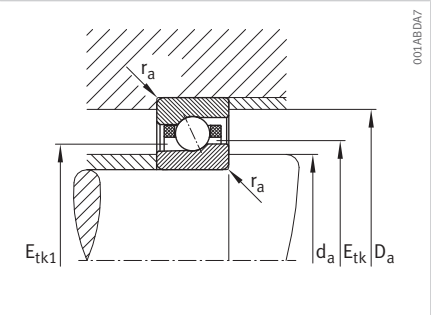
sealed



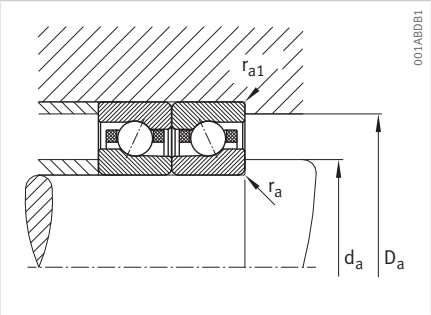




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCM71911-E-T-P4S-XL** | • | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **VCM71911-C-T-P4S-XL** | • | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 17 | 60 | 75,5 | 0,6 | 0,3 |
| **VCM71911-E-T-P4S-XL** | • | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 25 | 60 | 75,5 | 0,6 | 0,3 |
| **B7011-C-T-P4S** | • | 0,371 | 55 | 90 | 18 | 1,1 | 1,1 | 15 | 62 | 83 | 1 | 0,6 |
| **B7011-E-T-P4S** | • | 0,371 | 55 | 90 | 18 | 1,1 | 1,1 | 25 | 62 | 83 | 1 | 0,6 |
| **HCB7011-C-T-P4S** | • | 0,31 | 55 | 90 | 18 | 1,1 | 1,1 | 15 | 62 | 83 | 1 | 0,6 |
| **HCB7011-E-T-P4S** | • | 0,311 | 55 | 90 | 18 | 1,1 | 1,1 | 25 | 62 | 83 | 1 | 0,6 |
| **HS7011-C-T-P4S** | • | 0,405 | 55 | 90 | 18 | 1,1 | 1,1 | 15 | 62 | 83 | 1 | 0,6 |
| **HS7011-E-T-P4S** | • | 0,404 | 55 | 90 | 18 | 1,1 | 1,1 | 25 | 62 | 83 | 1 | 0,6 |
| **HC7011-E-T-P4S** | • | 0,386 | 55 | 90 | 18 | 1,1 | 1,1 | 25 | 62 | 83 | 1 | 0,6 |
| **M7011-C-T-P4S-XL** | • | 0,39 | 55 | 90 | 18 | 1,1 | 0,6 | 17 | 62 | 83 | 1 | 0,6 |
| **M7011-E-T-P4S-XL** | • | 0,39 | 55 | 90 | 18 | 1,1 | 0,6 | 25 | 62 | 83 | 1 | 0,6 |
| **HCM7011-C-T-P4S-XL** | • | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 17 | 62 | 83 | 1 | 0,6 |
| **HCM7011-E-T-P4S-XL** | • | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 25 | 62 | 83 | 1 | 0,6 |
| **VCM7011-C-T-P4S-XL** | • | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 17 | 62 | 83 | 1 | 0,6 |
| **VCM7011-E-T-P4S-XL** | • | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 25 | 62 | 83 | 1 | 0,6 |
| **B7211-C-T-P4S** | • | 0,619 | 55 | 100 | 21 | 1,5 | 1,5 | 15 | 63 | 92 | 1,5 | 0,6 |
| **B7211-E-T-P4S** | • | 0,617 | 55 | 100 | 21 | 1,5 | 1,5 | 25 | 63 | 92 | 1,5 | 0,6 |
| **HCB7211-C-T-P4S** | • | 0,546 | 55 | 100 | 21 | 1,5 | 1,5 | 15 | 63 | 92 | 1,5 | 0,6 |
| **HCB7211-E-T-P4S** | • | 0,544 | 55 | 100 | 21 | 1,5 | 1,5 | 25 | 63 | 92 | 1,5 | 0,6 |
| **B71912-C-T-P4S** | • | 0,188 | 60 | 85 | 13 | 1 | 1 | 15 | 65 | 80,5 | 0,6 | 0,3 |
| **B71912-E-T-P4S** | • | 0,188 | 60 | 85 | 13 | 1 | 1 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **HCB71912-C-T-P4S** | • | 0,159 | 60 | 85 | 13 | 1 | 1 | 15 | 65 | 80,5 | 0,6 | 0,3 |
| **HCB71912-E-T-P4S** | • | 0,159 | 60 | 85 | 13 | 1 | 1 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **HS71912-C-T-P4S** | • | 0,2 | 60 | 85 | 13 | 1 | 1 | 15 | 65 | 80,5 | 0,6 | 0,3 |
| **HS71912-E-T-P4S** | • | 0,2 | 60 | 85 | 13 | 1 | 1 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **HC71912-E-T-P4S** | • | 0,185 | 60 | 85 | 13 | 1 | 1 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **M71912-C-T-P4S-XL** | • | 0,17 | 60 | 85 | 13 | 1 | 0,6 | 17 | 65 | 80,5 | 0,6 | 0,3 |
| **M71912-E-T-P4S-XL** | • | 0,17 | 60 | 85 | 13 | 1 | 0,6 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **HCM71912-C-T-P4S-XL** | • | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 17 | 65 | 80,5 | 0,6 | 0,3 |
| **HCM71912-E-T-P4S-XL** | • | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **VCM71912-C-T-P4S-XL** | • | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 17 | 65 | 80,5 | 0,6 | 0,3 |
| **VCM71912-E-T-P4S-XL** | • | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 25 | 65 | 80,5 | 0,6 | 0,3 |
| **B7012-C-T-P4S** | • | 0,395 | 60 | 95 | 18 | 1,1 | 1,1 | 15 | 67 | 88 | 1 | 0,6 |
| **B7012-E-T-P4S** | • | 0,396 | 60 | 95 | 18 | 1,1 | 1,1 | 25 | 67 | 88 | 1 | 0,6 |
| **HCB7012-C-T-P4S** | • | 0,335 | 60 | 95 | 18 | 1,1 | 1,1 | 15 | 67 | 88 | 1 | 0,6 |
| **HCB7012-E-T-P4S** | • | 0,335 | 60 | 95 | 18 | 1,1 | 1,1 | 25 | 67 | 88 | 1 | 0,6 |
| **HS7012-C-T-P4S** | • | 0,433 | 60 | 95 | 18 | 1,1 | 1,1 | 15 | 67 | 88 | 1 | 0,6 |
| **HS7012-E-T-P4S** | • | 0,433 | 60 | 95 | 18 | 1,1 | 1,1 | 25 | 67 | 88 | 1 | 0,6 |
| **HC7012-E-T-P4S** | • | 0,413 | 60 | 95 | 18 | 1,1 | 1,1 | 25 | 67 | 88 | 1 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 62,7 | 59,7 | 65,1 | 65,1 | 17700 | 9100 | 28000 | 43000 | 106 | 277 | 575 | 303 | 801 | 1687 | 100 | 140 | 183 |
| 62,7 | 59,7 | 65,1 | 65,1 | 44500 | 13300 | 32000 | 48000 | 66 | 174 | 363 | 191 | 514 | 1105 | 49 | 70 | 94 |
| 62,7 | 59,7 | 65,1 | 65,1 | 42500 | 12700 | 30000 | 45000 | 95 | 249 | 516 | 272 | 718 | 1509 | 100 | 139 | 182 |
| 65,9 | 65,9 | 69,6 | 69,6 | 38500 | 22100 | 16000 | 24000 | 205 | 670 | 1344 | 635 | 2253 | 4837 | 61 | 106 | 151 |
| 65,9 | 65,9 | 69,6 | 69,6 | 37000 | 21000 | 14000 | 22000 | 296 | 1059 | 2234 | 862 | 3197 | 6983 | 142 | 230 | 314 |
| 65,9 | 65,9 | 69,6 | 69,6 | 39000 | 21200 | 22000 | 34000 | 102 | 366 | 765 | 305 | 1158 | 2559 | 52 | 88 | 124 |
| 65,9 | 65,9 | 69,6 | 69,6 | 37000 | 20100 | 20000 | 30000 | 136 | 562 | 1236 | 390 | 1653 | 3728 | 121 | 203 | 275 |
| 68,5 | 65,9 | 70,3 | 70,3 | 17900 | 11500 | 22000 | 34000 | 62 | 187 | 374 | 187 | 588 | 1225 | 42 | 67 | 91 |
| 68,5 | 65,9 | 70,3 | 70,3 | 16900 | 10900 | 20000 | 30000 | 101 | 304 | 607 | 292 | 895 | 1826 | 106 | 157 | 206 |
| 68,5 | 65,9 | 70,3 | 70,3 | 17000 | 10400 | 26000 | 40000 | 70 | 210 | 421 | 201 | 613 | 1244 | 105 | 155 | 201 |
| 67,7 | 64,7 | 70,1 | 70,1 | 19400 | 11000 | 22000 | 34000 | 116 | 306 | 645 | 340 | 931 | 2038 | 55 | 80 | 110 |
| 67,7 | 64,7 | 70,1 | 70,1 | 18500 | 10500 | 22000 | 32000 | 166 | 435 | 908 | 477 | 1271 | 2700 | 110 | 155 | 205 |
| 67,7 | 64,7 | 70,1 | 70,1 | 19500 | 10500 | 28000 | 40000 | 81 | 214 | 450 | 236 | 638 | 1378 | 54 | 78 | 105 |
| 67,7 | 64,7 | 70,1 | 70,1 | 18600 | 10000 | 26000 | 38000 | 117 | 306 | 637 | 335 | 887 | 1869 | 110 | 154 | 201 |
| 67,7 | 64,7 | 70,1 | 70,1 | 46500 | 14700 | 28000 | 45000 | 73 | 192 | 403 | 212 | 570 | 1225 | 54 | 77 | 103 |
| 67,7 | 64,7 | 70,1 | 70,1 | 44500 | 14000 | 28000 | 40000 | 105 | 275 | 572 | 301 | 794 | 1671 | 109 | 153 | 200 |
| 69,9 | 69,9 | 74,3 | 74,3 | 47000 | 26500 | 14000 | 22000 | 258 | 832 | 1662 | 800 | 2800 | 5985 | 67 | 114 | 163 |
| 69,9 | 69,9 | 74,3 | 74,3 | 45000 | 25000 | 13000 | 20000 | 378 | 1321 | 2767 | 1103 | 3991 | 8652 | 155 | 249 | 339 |
| 69,9 | 69,9 | 74,3 | 74,3 | 47000 | 25000 | 18000 | 30000 | 132 | 460 | 956 | 395 | 1460 | 3203 | 57 | 96 | 135 |
| 69,9 | 69,9 | 74,3 | 74,3 | 45000 | 24000 | 15000 | 24000 | 180 | 709 | 1540 | 518 | 2088 | 4646 | 134 | 220 | 297 |
| 67,8 | 67,8 | 70,1 | 70,1 | 24700 | 16000 | 16000 | 24000 | 116 | 401 | 822 | 354 | 1333 | 2919 | 55 | 95 | 137 |
| 67,8 | 67,8 | 70,1 | 70,1 | 23400 | 15200 | 14000 | 22000 | 155 | 617 | 1344 | 448 | 1853 | 4171 | 124 | 208 | 286 |
| 67,8 | 67,8 | 70,1 | 70,1 | 24700 | 15300 | 22000 | 34000 | 54 | 214 | 462 | 159 | 671 | 1530 | 45 | 79 | 112 |
| 67,8 | 67,8 | 70,1 | 70,1 | 23400 | 14500 | 20000 | 30000 | 57 | 303 | 707 | 163 | 887 | 2118 | 99 | 179 | 246 |
| 69,2 | 67,1 | 70,4 | 70,4 | 13400 | 9200 | 22000 | 34000 | 47 | 141 | 281 | 140 | 442 | 920 | 40 | 62 | 85 |
| 69,2 | 67,1 | 70,4 | 70,4 | 12600 | 8700 | 20000 | 30000 | 76 | 228 | 455 | 219 | 670 | 1368 | 99 | 147 | 192 |
| 69,2 | 67,1 | 70,4 | 70,4 | 12700 | 8300 | 26000 | 40000 | 52 | 155 | 311 | 148 | 452 | 917 | 98 | 144 | 186 |
| 67,7 | 64,7 | 70 | 70 | 19400 | 11000 | 22000 | 34000 | 116 | 306 | 645 | 340 | 931 | 2038 | 55 | 80 | 110 |
| 67,7 | 64,7 | 70 | 70 | 18500 | 10500 | 22000 | 32000 | 166 | 435 | 908 | 477 | 1271 | 2700 | 110 | 155 | 205 |
| 67,7 | 64,7 | 70 | 70 | 19500 | 10500 | 28000 | 40000 | 81 | 214 | 450 | 236 | 638 | 1378 | 54 | 78 | 105 |
| 67,7 | 64,7 | 70 | 70 | 18600 | 10000 | 26000 | 38000 | 117 | 306 | 637 | 335 | 887 | 1869 | 110 | 154 | 201 |
| 67,7 | 64,7 | 70 | 70 | 46500 | 14700 | 28000 | 45000 | 73 | 192 | 403 | 212 | 570 | 1225 | 54 | 77 | 103 |
| 67,7 | 64,7 | 70 | 70 | 44500 | 14000 | 28000 | 40000 | 105 | 275 | 572 | 301 | 794 | 1671 | 109 | 153 | 200 |
| 70,9 | 70,9 | 74,5 | 74,5 | 40000 | 23800 | 15000 | 22000 | 209 | 687 | 1381 | 647 | 2304 | 4952 | 64 | 110 | 157 |
| 70,9 | 70,9 | 74,5 | 74,5 | 38000 | 22600 | 13000 | 20000 | 297 | 1069 | 2259 | 864 | 3221 | 7045 | 147 | 239 | 326 |
| 70,9 | 70,9 | 74,5 | 74,5 | 40000 | 22700 | 20000 | 32000 | 106 | 379 | 794 | 315 | 1198 | 2651 | 54 | 92 | 130 |
| 70,9 | 70,9 | 74,5 | 74,5 | 38000 | 21600 | 19000 | 28000 | 136 | 569 | 1256 | 391 | 1673 | 3782 | 126 | 211 | 286 |
| 73,5 | 70,9 | 75,3 | 75,3 | 18600 | 12500 | 20000 | 32000 | 65 | 194 | 388 | 194 | 609 | 1269 | 45 | 71 | 96 |
| 73,5 | 70,9 | 75,3 | 75,3 | 17600 | 11800 | 18000 | 28000 | 105 | 316 | 631 | 304 | 929 | 1896 | 112 | 167 | 218 |
| 73,5 | 70,9 | 75,3 | 75,3 | 17600 | 11300 | 24000 | 36000 | 73 | 219 | 438 | 209 | 638 | 1294 | 112 | 165 | 213 |

## 2.2.2 Spindle bearings

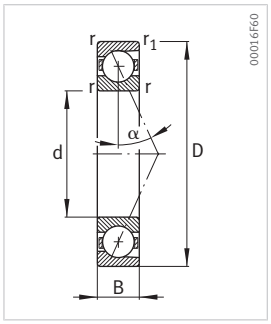
With large, medium or small balls

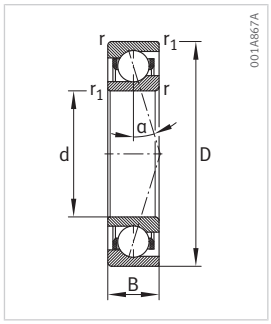
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

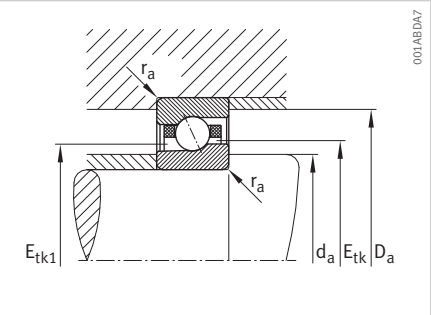
sealed



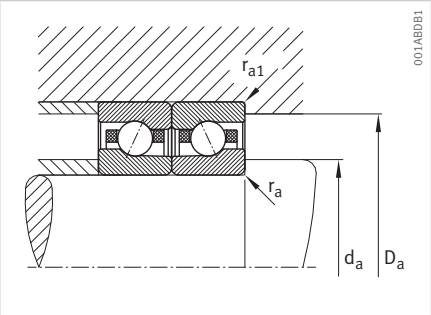




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **M7012-C-T-P4S-XL** | • | 0,42 | 60 | 95 | 18 | 1,1 | 0,6 | 17 | 67 | 88 | 1 | 0,6 |
| **M7012-E-T-P4S-XL** | • | 0,42 | 60 | 95 | 18 | 1,1 | 0,6 | 25 | 67 | 88 | 1 | 0,6 |
| **HCM7012-C-T-P4S-XL** | • | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 17 | 67 | 88 | 1 | 0,6 |
| **HCM7012-E-T-P4S-XL** | • | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 25 | 67 | 88 | 1 | 0,6 |
| **VCM7012-C-T-P4S-XL** | • | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 17 | 67 | 88 | 1 | 0,6 |
| **VCM7012-E-T-P4S-XL** | • | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 25 | 67 | 88 | 1 | 0,6 |
| **B7212-C-T-P4S** | • | 0,795 | 60 | 110 | 22 | 1,5 | 1,5 | 15 | 69,5 | 101,5 | 1,5 | 0,6 |
| **B7212-E-T-P4S** | • | 0,793 | 60 | 110 | 22 | 1,5 | 1,5 | 25 | 69,5 | 101,5 | 1,5 | 0,6 |
| **HCB7212-C-T-P4S** | • | 0,687 | 60 | 110 | 22 | 1,5 | 1,5 | 15 | 69,5 | 101,5 | 1,5 | 0,6 |
| **HCB7212-E-T-P4S** | • | 0,685 | 60 | 110 | 22 | 1,5 | 1,5 | 25 | 69,5 | 101,5 | 1,5 | 0,6 |
| **B71913-C-T-P4S** | • | 0,2 | 65 | 90 | 13 | 1 | 1 | 15 | 70 | 85,5 | 0,6 | 0,3 |
| **B71913-E-T-P4S** | • | 0,2 | 65 | 90 | 13 | 1 | 1 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **HCB71913-C-T-P4S** | • | 0,17 | 65 | 90 | 13 | 1 | 1 | 15 | 70 | 85,5 | 0,6 | 0,3 |
| **HCB71913-E-T-P4S** | • | 0,17 | 65 | 90 | 13 | 1 | 1 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **HS71913-C-T-P4S** | • | 0,214 | 65 | 90 | 13 | 1 | 1 | 15 | 70 | 85,5 | 0,6 | 0,3 |
| **HS71913-E-T-P4S** | • | 0,214 | 65 | 90 | 13 | 1 | 1 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **HC71913-E-T-P4S** | • | 0,198 | 65 | 90 | 13 | 1 | 1 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **M71913-C-T-P4S-XL** | • | 0,18 | 65 | 90 | 13 | 1 | 0,6 | 17 | 70 | 85,5 | 0,6 | 0,3 |
| **M71913-E-T-P4S-XL** | • | 0,18 | 65 | 90 | 13 | 1 | 0,6 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **HCM71913-C-T-P4S-XL** | • | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 17 | 70 | 85,5 | 0,6 | 0,3 |
| **HCM71913-E-T-P4S-XL** | • | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **VCM71913-C-T-P4S-XL** | • | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 17 | 70 | 85,5 | 0,6 | 0,3 |
| **VCM71913-E-T-P4S-XL** | • | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 25 | 70 | 85,5 | 0,6 | 0,3 |
| **B7013-C-T-P4S** | • | 0,42 | 65 | 100 | 18 | 1,1 | 1,1 | 15 | 72 | 93 | 1 | 0,6 |
| **B7013-E-T-P4S** | • | 0,42 | 65 | 100 | 18 | 1,1 | 1,1 | 25 | 72 | 93 | 1 | 0,6 |
| **HCB7013-C-T-P4S** | • | 0,356 | 65 | 100 | 18 | 1,1 | 1,1 | 15 | 72 | 93 | 1 | 0,6 |
| **HCB7013-E-T-P4S** | • | 0,356 | 65 | 100 | 18 | 1,1 | 1,1 | 25 | 72 | 93 | 1 | 0,6 |
| **HS7013-C-T-P4S** | • | 0,461 | 65 | 100 | 18 | 1,1 | 1,1 | 15 | 72 | 93 | 1 | 0,6 |
| **HS7013-E-T-P4S** | • | 0,461 | 65 | 100 | 18 | 1,1 | 1,1 | 25 | 72 | 93 | 1 | 0,6 |
| **HC7013-E-T-P4S** | • | 0,44 | 65 | 100 | 18 | 1,1 | 1,1 | 25 | 72 | 93 | 1 | 0,6 |
| **M7013-C-T-P4S-XL** | • | 0,44 | 65 | 100 | 18 | 1,1 | 0,6 | 17 | 72 | 93 | 1 | 0,6 |
| **M7013-E-T-P4S-XL** | • | 0,44 | 65 | 100 | 18 | 1,1 | 0,6 | 25 | 72 | 93 | 1 | 0,6 |
| **HCM7013-C-T-P4S-XL** | • | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 17 | 72 | 93 | 1 | 0,6 |
| **HCM7013-E-T-P4S-XL** | • | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 25 | 72 | 93 | 1 | 0,6 |
| **VCM7013-C-T-P4S-XL** | • | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 17 | 72 | 93 | 1 | 0,6 |
| **VCM7013-E-T-P4S-XL** | • | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 25 | 72 | 93 | 1 | 0,6 |
| **B7213-C-T-P4S** | • | 1 | 65 | 120 | 23 | 1,5 | 1,5 | 15 | 75,5 | 109,5 | 1,5 | 0,6 |
| **B7213-E-T-P4S** | • | 0,998 | 65 | 120 | 23 | 1,5 | 1,5 | 25 | 75,5 | 109,5 | 1,5 | 0,6 |
| **HCB7213-C-T-P4S** | • | 0,866 | 65 | 120 | 23 | 1,5 | 1,5 | 15 | 75,5 | 109,5 | 1,5 | 0,6 |
| **HCB7213-E-T-P4S** | • | 0,863 | 65 | 120 | 23 | 1,5 | 1,5 | 25 | 75,5 | 109,5 | 1,5 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 72,7 | 69,7 | 75,1 | 75,1 | 19800 | 11600 | 22000 | 32000 | 122 | 323 | 680 | 358 | 981 | 2150 | 57 | 84 | 115 |
| 72,7 | 69,7 | 75,1 | 75,1 | 18800 | 11000 | 20000 | 30000 | 175 | 458 | 956 | 503 | 1339 | 2845 | 115 | 162 | 214 |
| 72,7 | 69,7 | 75,1 | 75,1 | 19800 | 11100 | 26000 | 38000 | 86 | 226 | 474 | 249 | 673 | 1453 | 57 | 81 | 110 |
| 72,7 | 69,7 | 75,1 | 75,1 | 18900 | 10600 | 26000 | 36000 | 123 | 323 | 671 | 353 | 934 | 1968 | 115 | 161 | 211 |
| 72,7 | 69,7 | 75,1 | 75,1 | 47500 | 15500 | 28000 | 43000 | 77 | 203 | 424 | 223 | 601 | 1292 | 56 | 81 | 108 |
| 72,7 | 69,7 | 75,1 | 75,1 | 45500 | 14800 | 26000 | 38000 | 111 | 290 | 602 | 317 | 837 | 1760 | 115 | 160 | 209 |
| 77 | 77 | 81,9 | 81,9 | 56000 | 31000 | 13000 | 20000 | 312 | 996 | 1982 | 968 | 3352 | 7140 | 71 | 121 | 172 |
| 77 | 77 | 81,9 | 81,9 | 53000 | 29500 | 12000 | 19000 | 463 | 1586 | 3304 | 1351 | 4794 | 10334 | 165 | 264 | 358 |
| 77 | 77 | 81,9 | 81,9 | 56000 | 29500 | 16000 | 26000 | 163 | 557 | 1149 | 488 | 1767 | 3852 | 61 | 102 | 143 |
| 77 | 77 | 81,9 | 81,9 | 53000 | 28500 | 14000 | 22000 | 226 | 859 | 1847 | 651 | 2531 | 5576 | 144 | 234 | 315 |
| 72,8 | 72,8 | 75,1 | 75,1 | 25000 | 16900 | 15000 | 22000 | 117 | 409 | 839 | 360 | 1356 | 2973 | 56 | 98 | 141 |
| 72,8 | 72,8 | 75,1 | 75,1 | 23700 | 16000 | 13000 | 20000 | 152 | 613 | 1339 | 440 | 1837 | 4145 | 126 | 213 | 293 |
| 72,8 | 72,8 | 75,1 | 75,1 | 25000 | 16100 | 20000 | 32000 | 55 | 219 | 473 | 161 | 684 | 1562 | 47 | 82 | 116 |
| 72,8 | 72,8 | 75,1 | 75,1 | 23800 | 15300 | 19000 | 28000 | 58 | 309 | 723 | 165 | 904 | 2165 | 102 | 185 | 255 |
| 74,2 | 72,1 | 75,3 | 75,3 | 13800 | 9900 | 20000 | 32000 | 48 | 144 | 287 | 143 | 450 | 937 | 42 | 65 | 89 |
| 74,2 | 72,1 | 75,3 | 75,3 | 13000 | 9300 | 18000 | 28000 | 77 | 231 | 462 | 222 | 680 | 1386 | 104 | 154 | 201 |
| 74,2 | 72,1 | 75,3 | 75,3 | 13000 | 8900 | 24000 | 36000 | 53 | 160 | 321 | 153 | 466 | 946 | 103 | 152 | 196 |
| 72,7 | 69,7 | 75 | 75 | 19800 | 11600 | 22000 | 32000 | 122 | 323 | 680 | 358 | 981 | 2150 | 57 | 84 | 115 |
| 72,7 | 69,7 | 75 | 75 | 18800 | 11000 | 20000 | 30000 | 175 | 458 | 956 | 503 | 1339 | 2845 | 115 | 162 | 214 |
| 72,7 | 69,7 | 75 | 75 | 19800 | 11100 | 26000 | 38000 | 86 | 226 | 474 | 249 | 673 | 1453 | 57 | 81 | 110 |
| 72,7 | 69,7 | 75 | 75 | 18900 | 10600 | 26000 | 36000 | 123 | 323 | 671 | 353 | 934 | 1968 | 115 | 161 | 211 |
| 72,7 | 69,7 | 75 | 75 | 47500 | 15500 | 28000 | 43000 | 77 | 203 | 424 | 223 | 601 | 1292 | 56 | 81 | 108 |
| 72,7 | 69,7 | 75 | 75 | 45500 | 14800 | 26000 | 38000 | 111 | 290 | 602 | 317 | 837 | 1760 | 115 | 160 | 209 |
| 75,9 | 75,9 | 79,5 | 79,5 | 41500 | 25500 | 14000 | 22000 | 214 | 704 | 1417 | 660 | 2354 | 5068 | 67 | 114 | 164 |
| 75,9 | 75,9 | 79,5 | 79,5 | 39000 | 24100 | 13000 | 19000 | 308 | 1111 | 2350 | 896 | 3347 | 7323 | 154 | 251 | 342 |
| 75,9 | 75,9 | 79,5 | 79,5 | 41500 | 24300 | 19000 | 30000 | 107 | 385 | 808 | 318 | 1213 | 2688 | 56 | 96 | 135 |
| 75,9 | 75,9 | 79,5 | 79,5 | 39500 | 23100 | 17000 | 26000 | 137 | 577 | 1276 | 392 | 1694 | 3836 | 131 | 219 | 297 |
| 78,5 | 75,9 | 80,2 | 80,2 | 19300 | 13400 | 19000 | 30000 | 67 | 201 | 402 | 200 | 630 | 1312 | 47 | 74 | 102 |
| 78,5 | 75,9 | 80,2 | 80,2 | 18200 | 12700 | 17000 | 26000 | 109 | 328 | 656 | 315 | 964 | 1967 | 119 | 177 | 231 |
| 78,5 | 75,9 | 80,2 | 80,2 | 18200 | 12200 | 22000 | 34000 | 74 | 223 | 445 | 213 | 647 | 1313 | 118 | 173 | 224 |
| 77,7 | 74,7 | 80 | 80 | 20100 | 12100 | 20000 | 30000 | 128 | 339 | 715 | 377 | 1032 | 2260 | 60 | 88 | 120 |
| 77,7 | 74,7 | 80 | 80 | 19100 | 11600 | 19000 | 28000 | 183 | 481 | 1004 | 528 | 1406 | 2988 | 120 | 170 | 224 |
| 77,7 | 74,7 | 80 | 80 | 20100 | 11600 | 24000 | 36000 | 90 | 237 | 498 | 262 | 707 | 1528 | 59 | 85 | 115 |
| 77,7 | 74,7 | 80 | 80 | 19200 | 11100 | 24000 | 34000 | 129 | 339 | 705 | 371 | 981 | 2067 | 120 | 169 | 220 |
| 77,7 | 74,7 | 80 | 80 | 48000 | 16300 | 26000 | 40000 | 81 | 213 | 446 | 234 | 631 | 1358 | 59 | 84 | 113 |
| 77,7 | 74,7 | 80 | 80 | 46000 | 15500 | 24000 | 36000 | 116 | 304 | 632 | 333 | 879 | 1849 | 120 | 168 | 218 |
| 83 | 83 | 88,6 | 88,6 | 68000 | 38500 | 12000 | 19000 | 386 | 1224 | 2431 | 1198 | 4118 | 8752 | 79 | 134 | 191 |
| 83 | 83 | 88,6 | 88,6 | 65000 | 36500 | 11000 | 18000 | 585 | 1977 | 4100 | 1709 | 5978 | 12828 | 185 | 295 | 399 |
| 83 | 83 | 88,6 | 88,6 | 68000 | 36500 | 15000 | 24000 | 205 | 690 | 1419 | 614 | 2192 | 4757 | 68 | 113 | 159 |
| 83 | 83 | 88,6 | 88,6 | 65000 | 35000 | 13000 | 20000 | 290 | 1071 | 2286 | 834 | 3157 | 6901 | 162 | 261 | 350 |

## 2.2.2 Spindle bearings

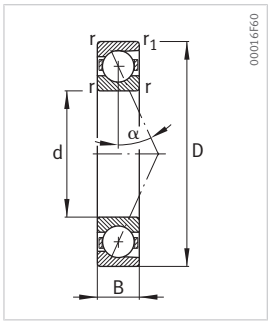
With large, medium or small balls

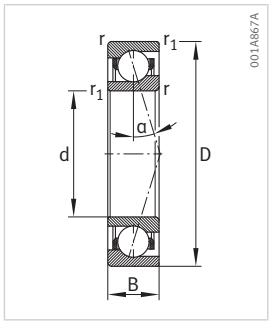
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

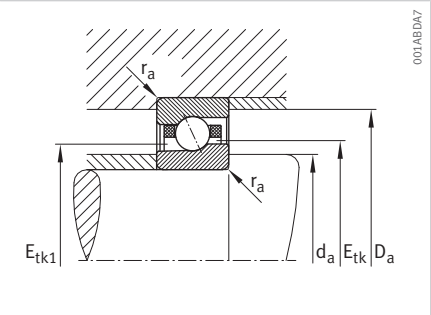
sealed



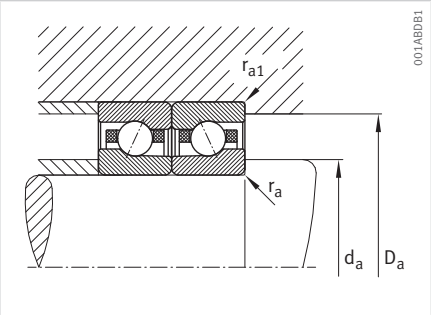




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B71914-C-T-P4S** | • | 0,33 | 70 | 100 | 16 | 1 | 1 | 15 | 76 | 94,5 | 0,6 | 0,3 |
| **B71914-E-T-P4S** | • | 0,33 | 70 | 100 | 16 | 1 | 1 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **HCB71914-C-T-P4S** | • | 0,28 | 70 | 100 | 16 | 1 | 1 | 15 | 76 | 94,5 | 0,6 | 0,3 |
| **HCB71914-E-T-P4S** | • | 0,28 | 70 | 100 | 16 | 1 | 1 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **HS71914-C-T-P4S** | • | 0,354 | 70 | 100 | 16 | 1 | 1 | 15 | 76 | 94,5 | 0,6 | 0,3 |
| **HS71914-E-T-P4S** | • | 0,353 | 70 | 100 | 16 | 1 | 1 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **HC71914-E-T-P4S** | • | 0,334 | 70 | 100 | 16 | 1 | 1 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **M71914-C-T-P4S-XL** | • | 0,3 | 70 | 100 | 16 | 1 | 0,6 | 17 | 76 | 94,5 | 0,6 | 0,3 |
| **M71914-E-T-P4S-XL** | • | 0,3 | 70 | 100 | 16 | 1 | 0,6 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **HCM71914-C-T-P4S-XL** | • | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 17 | 76 | 94,5 | 0,6 | 0,3 |
| **HCM71914-E-T-P4S-XL** | • | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **VCM71914-C-T-P4S-XL** | • | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 17 | 76 | 94,5 | 0,6 | 0,3 |
| **VCM71914-E-T-P4S-XL** | • | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 25 | 76 | 94,5 | 0,6 | 0,3 |
| **B7014-C-T-P4S** | • | 0,59 | 70 | 110 | 20 | 1,1 | 1,1 | 15 | 77 | 102 | 1 | 0,6 |
| **B7014-E-T-P4S** | • | 0,59 | 70 | 110 | 20 | 1,1 | 1,1 | 25 | 77 | 102 | 1 | 0,6 |
| **HCB7014-C-T-P4S** | • | 0,495 | 70 | 110 | 20 | 1,1 | 1,1 | 15 | 77 | 102 | 1 | 0,6 |
| **HCB7014-E-T-P4S** | • | 0,495 | 70 | 110 | 20 | 1,1 | 1,1 | 25 | 77 | 102 | 1 | 0,6 |
| **HS7014-C-T-P4S** | • | 0,644 | 70 | 110 | 20 | 1,1 | 1,1 | 15 | 77 | 102 | 1 | 0,6 |
| **HS7014-E-T-P4S** | • | 0,643 | 70 | 110 | 20 | 1,1 | 1,1 | 25 | 77 | 102 | 1 | 0,6 |
| **HC7014-E-T-P4S** | • | 0,611 | 70 | 110 | 20 | 1,1 | 1,1 | 25 | 77 | 102 | 1 | 0,6 |
| **M7014-C-T-P4S-XL** | • | 0,61 | 70 | 110 | 20 | 1,1 | 0,6 | 17 | 77 | 102 | 1 | 0,6 |
| **M7014-E-T-P4S-XL** | • | 0,61 | 70 | 110 | 20 | 1,1 | 0,6 | 25 | 77 | 102 | 1 | 0,6 |
| **HCM7014-C-T-P4S-XL** | • | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 17 | 77 | 102 | 1 | 0,6 |
| **HCM7014-E-T-P4S-XL** | • | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 25 | 77 | 102 | 1 | 0,6 |
| **VCM7014-C-T-P4S-XL** | • | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 17 | 77 | 102 | 1 | 0,6 |
| **VCM7014-E-T-P4S-XL** | • | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 25 | 77 | 102 | 1 | 0,6 |
| **B7214-C-T-P4S** | | 1,1 | 70 | 125 | 24 | 1,5 | 1,5 | 15 | 80 | 115 | 1,5 | 0,6 |
| **B7214-E-T-P4S** | | 1,09 | 70 | 125 | 24 | 1,5 | 1,5 | 25 | 80 | 115 | 1,5 | 0,6 |
| **HCB7214-C-T-P4S** | | 0,954 | 70 | 125 | 24 | 1,5 | 1,5 | 15 | 80 | 115 | 1,5 | 0,6 |
| **HCB7214-E-T-P4S** | | 0,951 | 70 | 125 | 24 | 1,5 | 1,5 | 25 | 80 | 115 | 1,5 | 0,6 |
| **B71915-C-T-P4S** | • | 0,347 | 75 | 105 | 16 | 1 | 1 | 15 | 81 | 99,5 | 0,6 | 0,3 |
| **B71915-E-T-P4S** | • | 0,347 | 75 | 105 | 16 | 1 | 1 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **HCB71915-C-T-P4S** | • | 0,285 | 75 | 105 | 16 | 1 | 1 | 15 | 81 | 99,5 | 0,6 | 0,3 |
| **HCB71915-E-T-P4S** | • | 0,285 | 75 | 105 | 16 | 1 | 1 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **HS71915-C-T-P4S** | • | 0,374 | 75 | 105 | 16 | 1 | 1 | 15 | 81 | 99,5 | 0,6 | 0,3 |
| **HS71915-E-T-P4S** | • | 0,373 | 75 | 105 | 16 | 1 | 1 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **HC71915-E-T-P4S** | • | 0,353 | 75 | 105 | 16 | 1 | 1 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **M71915-C-T-P4S-XL** | • | 0,32 | 75 | 105 | 16 | 1 | 0,6 | 17 | 81 | 99,5 | 0,6 | 0,3 |
| **M71915-E-T-P4S-XL** | • | 0,32 | 75 | 105 | 16 | 1 | 0,6 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **HCM71915-C-T-P4S-XL** | • | 0,27 | 75 | 105 | 16 | 1 | 0,6 | 17 | 81 | 99,5 | 0,6 | 0,3 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 79,3 | 79,3 | 82,2 | 82,2 | 34500 | 23000 | 14000 | 20000 | 170 | 576 | 1171 | 523 | 1912 | 4155 | 66 | 114 | 163 |
| 79,3 | 79,3 | 82,2 | 82,2 | 32500 | 21800 | 12000 | 19000 | 233 | 886 | 1902 | 677 | 2658 | 5898 | 151 | 249 | 341 |
| 79,3 | 79,3 | 82,2 | 82,2 | 34500 | 22000 | 19000 | 28000 | 83 | 312 | 665 | 245 | 980 | 2200 | 56 | 95 | 135 |
| 79,3 | 79,3 | 82,2 | 82,2 | 32500 | 20800 | 17000 | 26000 | 98 | 459 | 1040 | 281 | 1343 | 3118 | 126 | 218 | 298 |
| 81,2 | 78,8 | 82,6 | 82,6 | 17800 | 12900 | 19000 | 28000 | 61 | 184 | 368 | 183 | 576 | 1198 | 47 | 74 | 101 |
| 81,2 | 78,8 | 82,6 | 82,6 | 16800 | 12200 | 17000 | 26000 | 99 | 298 | 597 | 287 | 877 | 1789 | 118 | 176 | 229 |
| 81,2 | 78,8 | 82,6 | 82,6 | 16800 | 11700 | 22000 | 34000 | 69 | 207 | 414 | 198 | 602 | 1221 | 117 | 173 | 223 |
| 79,3 | 75,7 | 82,1 | 82,1 | 27000 | 15700 | 19000 | 30000 | 165 | 437 | 921 | 485 | 1327 | 2905 | 65 | 96 | 131 |
| 79,3 | 75,7 | 82,1 | 82,1 | 26000 | 15000 | 18000 | 28000 | 237 | 621 | 1295 | 681 | 1813 | 3851 | 131 | 186 | 245 |
| 79,3 | 75,7 | 82,1 | 82,1 | 27000 | 15000 | 24000 | 36000 | 116 | 306 | 641 | 337 | 910 | 1965 | 65 | 93 | 125 |
| 79,3 | 75,7 | 82,1 | 82,1 | 26000 | 14300 | 22000 | 32000 | 167 | 437 | 909 | 478 | 1265 | 2665 | 132 | 184 | 241 |
| 79,3 | 75,7 | 82,1 | 82,1 | 65000 | 21000 | 24000 | 38000 | 104 | 274 | 574 | 302 | 812 | 1747 | 64 | 92 | 123 |
| 79,3 | 75,7 | 82,1 | 82,1 | 62000 | 20100 | 24000 | 36000 | 150 | 393 | 816 | 429 | 1133 | 2383 | 131 | 183 | 239 |
| 82,4 | 82,4 | 86,7 | 86,7 | 50000 | 30500 | 13000 | 20000 | 276 | 894 | 1790 | 853 | 2995 | 6414 | 74 | 125 | 179 |
| 82,4 | 82,4 | 86,7 | 86,7 | 48000 | 29000 | 11000 | 18000 | 395 | 1388 | 2915 | 1149 | 4183 | 9083 | 169 | 273 | 371 |
| 82,4 | 82,4 | 86,7 | 86,7 | 50000 | 29500 | 18000 | 28000 | 139 | 487 | 1014 | 414 | 1538 | 3380 | 62 | 105 | 147 |
| 82,4 | 82,4 | 86,7 | 86,7 | 48000 | 28000 | 16000 | 24000 | 188 | 749 | 1633 | 540 | 2203 | 4915 | 147 | 242 | 326 |
| 85,2 | 82,3 | 87,5 | 87,5 | 25000 | 17200 | 18000 | 28000 | 87 | 261 | 523 | 261 | 820 | 1706 | 52 | 82 | 112 |
| 85,2 | 82,3 | 87,5 | 87,5 | 23600 | 16300 | 16000 | 24000 | 141 | 423 | 845 | 406 | 1243 | 2536 | 131 | 194 | 253 |
| 85,2 | 82,3 | 87,5 | 87,5 | 23700 | 15600 | 20000 | 32000 | 98 | 293 | 587 | 280 | 853 | 1731 | 130 | 192 | 248 |
| 84,3 | 80,7 | 87,2 | 87,2 | 27500 | 16500 | 18000 | 28000 | 173 | 460 | 969 | 510 | 1397 | 3060 | 68 | 100 | 137 |
| 84,3 | 80,7 | 87,2 | 87,2 | 26500 | 15700 | 17000 | 26000 | 249 | 653 | 1362 | 716 | 1908 | 4053 | 137 | 194 | 256 |
| 84,3 | 80,7 | 87,2 | 87,2 | 27500 | 15800 | 22000 | 34000 | 122 | 322 | 675 | 355 | 958 | 2069 | 68 | 97 | 131 |
| 84,3 | 80,7 | 87,2 | 87,2 | 26500 | 15100 | 22000 | 32000 | 176 | 460 | 956 | 503 | 1331 | 2804 | 138 | 193 | 252 |
| 84,3 | 80,7 | 87,2 | 87,2 | 66000 | 22100 | 24000 | 36000 | 110 | 289 | 605 | 318 | 855 | 1839 | 67 | 96 | 129 |
| 84,3 | 80,7 | 87,2 | 87,2 | 63000 | 21100 | 22000 | 34000 | 158 | 413 | 858 | 451 | 1192 | 2508 | 137 | 192 | 250 |
| 88 | 88 | 93,6 | 93,6 | 71000 | 41500 | 11000 | 18000 | 399 | 1269 | 2524 | 1238 | 4260 | 9062 | 83 | 141 | 201 |
| 88 | 88 | 93,6 | 93,6 | 67000 | 39500 | 10000 | 17000 | 595 | 2017 | 4189 | 1736 | 6090 | 13077 | 194 | 309 | 418 |
| 88 | 88 | 93,6 | 93,6 | 71000 | 39500 | 14000 | 22000 | 211 | 711 | 1464 | 630 | 2253 | 4894 | 72 | 119 | 166 |
| 88 | 88 | 93,6 | 93,6 | 67000 | 38000 | 12000 | 19000 | 297 | 1103 | 2359 | 854 | 3249 | 7111 | 171 | 275 | 368 |
| 84,3 | 84,3 | 87,2 | 87,2 | 35000 | 24200 | 13000 | 20000 | 172 | 584 | 1189 | 527 | 1933 | 4206 | 68 | 117 | 168 |
| 84,3 | 84,3 | 87,2 | 87,2 | 33000 | 22900 | 11000 | 18000 | 235 | 897 | 1928 | 682 | 2688 | 5970 | 156 | 257 | 351 |
| 84,3 | 84,3 | 87,2 | 87,2 | 35000 | 23100 | 18000 | 28000 | 83 | 317 | 676 | 247 | 991 | 2229 | 57 | 98 | 139 |
| 84,3 | 84,3 | 87,2 | 87,2 | 33000 | 21900 | 16000 | 24000 | 95 | 454 | 1034 | 273 | 1328 | 3094 | 128 | 223 | 305 |
| 86,2 | 83,9 | 87,5 | 87,5 | 18300 | 13800 | 18000 | 28000 | 64 | 191 | 382 | 190 | 597 | 1242 | 50 | 78 | 106 |
| 86,2 | 83,9 | 87,5 | 87,5 | 17200 | 13000 | 16000 | 24000 | 101 | 304 | 607 | 292 | 891 | 1817 | 123 | 183 | 239 |
| 86,2 | 83,9 | 87,5 | 87,5 | 17300 | 12500 | 20000 | 32000 | 70 | 210 | 421 | 201 | 611 | 1240 | 123 | 181 | 233 |
| 84,3 | 80,7 | 87,1 | 87,1 | 27500 | 16500 | 18000 | 28000 | 173 | 460 | 969 | 510 | 1397 | 3060 | 68 | 100 | 137 |
| 84,3 | 80,7 | 87,1 | 87,1 | 26500 | 15700 | 17000 | 26000 | 249 | 653 | 1362 | 716 | 1908 | 4053 | 137 | 194 | 256 |
| 84,3 | 80,7 | 87,1 | 87,1 | 27500 | 15800 | 22000 | 34000 | 122 | 322 | 675 | 355 | 958 | 2069 | 68 | 97 | 131 |

## 2.2.2 Spindle bearings

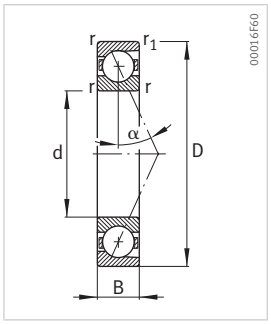
With large, medium or small balls

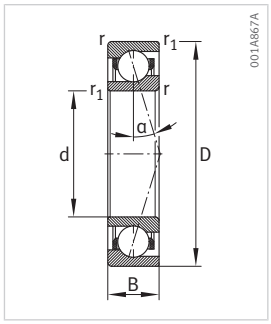
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

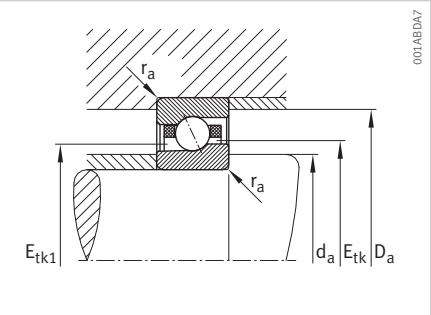
sealed



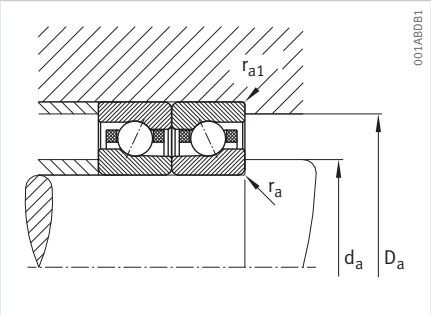




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCM71915-E-T-P4S-XL** | • | 0,27 | 75 | 105 | 16 | 1 | 0,6 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **VCM71915-C-T-P4S-XL** | • | 0,27 | 75 | 105 | 16 | 1 | 0,6 | 17 | 81 | 99,5 | 0,6 | 0,3 |
| **VCM71915-E-T-P4S-XL** | • | 0,27 | 75 | 105 | 16 | 1 | 0,6 | 25 | 81 | 99,5 | 0,6 | 0,3 |
| **B7015-C-T-P4S** | • | 0,62 | 75 | 115 | 20 | 1,1 | 1,1 | 15 | 82 | 107 | 1 | 0,6 |
| **B7015-E-T-P4S** | • | 0,62 | 75 | 115 | 20 | 1,1 | 1,1 | 25 | 82 | 107 | 1 | 0,6 |
| **HCB7015-C-T-P4S** | • | 0,52 | 75 | 115 | 20 | 1,1 | 1,1 | 15 | 82 | 107 | 1 | 0,6 |
| **HCB7015-E-T-P4S** | • | 0,52 | 75 | 115 | 20 | 1,1 | 1,1 | 25 | 82 | 107 | 1 | 0,6 |
| **HS7015-C-T-P4S** | • | 0,679 | 75 | 115 | 20 | 1,1 | 1,1 | 15 | 82 | 107 | 1 | 0,6 |
| **HS7015-E-T-P4S** | • | 0,678 | 75 | 115 | 20 | 1,1 | 1,1 | 25 | 82 | 107 | 1 | 0,6 |
| **HC7015-E-T-P4S** | • | 0,644 | 75 | 115 | 20 | 1,1 | 1,1 | 25 | 82 | 107 | 1 | 0,6 |
| **M7015-C-T-P4S-XL** | • | 0,64 | 75 | 115 | 20 | 1,1 | 0,6 | 17 | 82 | 107 | 1 | 0,6 |
| **M7015-E-T-P4S-XL** | • | 0,64 | 75 | 115 | 20 | 1,1 | 0,6 | 25 | 82 | 107 | 1 | 0,6 |
| **HCM7015-C-T-P4S-XL** | • | 0,59 | 75 | 115 | 20 | 1,1 | 0,6 | 17 | 82 | 107 | 1 | 0,6 |
| **HCM7015-E-T-P4S-XL** | • | 0,59 | 75 | 115 | 20 | 1,1 | 0,6 | 25 | 82 | 107 | 1 | 0,6 |
| **VCM7015-C-T-P4S-XL** | • | 0,59 | 75 | 115 | 20 | 1,1 | 0,6 | 17 | 82 | 107 | 1 | 0,6 |
| **VCM7015-E-T-P4S-XL** | • | 0,59 | 75 | 115 | 20 | 1,1 | 0,6 | 25 | 82 | 107 | 1 | 0,6 |
| **B7215-C-T-P4S** | • | 1,2 | 75 | 130 | 25 | 1,5 | 1,5 | 15 | 85 | 120 | 1,5 | 0,6 |
| **B7215-E-T-P4S** | • | 1,2 | 75 | 130 | 25 | 1,5 | 1,5 | 25 | 85 | 120 | 1,5 | 0,6 |
| **HCB7215-C-T-P4S** | • | 1,05 | 75 | 130 | 25 | 1,5 | 1,5 | 15 | 85 | 120 | 1,5 | 0,6 |
| **HCB7215-E-T-P4S** | • | 1,04 | 75 | 130 | 25 | 1,5 | 1,5 | 25 | 85 | 120 | 1,5 | 0,6 |
| **B71916-C-T-P4S** | • | 0,366 | 80 | 110 | 16 | 1 | 1 | 15 | 86 | 104 | 0,6 | 0,3 |
| **B71916-E-T-P4S** | • | 0,366 | 80 | 110 | 16 | 1 | 1 | 25 | 86 | 104 | 0,6 | 0,3 |
| **HCB71916-C-T-P4S** | • | 0,309 | 80 | 110 | 16 | 1 | 1 | 15 | 86 | 104 | 0,6 | 0,3 |
| **HCB71916-E-T-P4S** | • | 0,31 | 80 | 110 | 16 | 1 | 1 | 25 | 86 | 104 | 0,6 | 0,3 |
| **HS71916-C-T-P4S** | • | 0,379 | 80 | 110 | 16 | 1 | 1 | 15 | 86 | 104 | 0,6 | 0,3 |
| **HS71916-E-T-P4S** | • | 0,379 | 80 | 110 | 16 | 1 | 1 | 25 | 86 | 104 | 0,6 | 0,3 |
| **HC71916-E-T-P4S** | • | 0,355 | 80 | 110 | 16 | 1 | 1 | 25 | 86 | 104 | 0,6 | 0,3 |
| **M71916-C-T-P4S-XL** | • | 0,33 | 80 | 110 | 16 | 1 | 0,6 | 17 | 86 | 104 | 0,6 | 0,3 |
| **M71916-E-T-P4S-XL** | • | 0,33 | 80 | 110 | 16 | 1 | 0,6 | 25 | 86 | 104 | 0,6 | 0,3 |
| **HCM71916-C-T-P4S-XL** | • | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 17 | 86 | 104 | 0,6 | 0,3 |
| **HCM71916-E-T-P4S-XL** | • | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 25 | 86 | 104 | 0,6 | 0,3 |
| **VCM71916-C-T-P4S-XL** | • | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 17 | 86 | 104 | 0,6 | 0,3 |
| **VCM71916-E-T-P4S-XL** | • | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 25 | 86 | 104 | 0,6 | 0,3 |
| **B7016-C-T-P4S** | • | 0,84 | 80 | 125 | 22 | 1,1 | 1,1 | 15 | 88 | 117 | 1 | 0,6 |
| **B7016-E-T-P4S** | • | 0,84 | 80 | 125 | 22 | 1,1 | 1,1 | 25 | 88 | 117 | 1 | 0,6 |
| **HCB7016-C-T-P4S** | • | 0,7 | 80 | 125 | 22 | 1,1 | 1,1 | 15 | 88 | 117 | 1 | 0,6 |
| **HCB7016-E-T-P4S** | • | 0,7 | 80 | 125 | 22 | 1,1 | 1,1 | 25 | 88 | 117 | 1 | 0,6 |
| **HS7016-C-T-P4S** | • | 0,927 | 80 | 125 | 22 | 1,1 | 1,1 | 15 | 88 | 117 | 1 | 0,6 |
| **HS7016-E-T-P4S** | • | 0,925 | 80 | 125 | 22 | 1,1 | 1,1 | 25 | 88 | 117 | 1 | 0,6 |
| **HC7016-E-T-P4S** | • | 0,87 | 80 | 125 | 22 | 1,1 | 1,1 | 25 | 88 | 117 | 1 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 84,3 | 80,7 | 87,1 | 87,1 | 26500 | 15100 | 22000 | 32000 | 176 | 460 | 956 | 503 | 1331 | 2804 | 138 | 193 | 252 |
| 84,3 | 80,7 | 87,1 | 87,1 | 66000 | 22100 | 24000 | 36000 | 110 | 289 | 605 | 318 | 855 | 1839 | 67 | 96 | 129 |
| 84,3 | 80,7 | 87,1 | 87,1 | 63000 | 21100 | 22000 | 34000 | 158 | 413 | 858 | 451 | 1192 | 2508 | 137 | 192 | 250 |
| 87,4 | 87,4 | 91,7 | 91,7 | 52000 | 32500 | 12000 | 19000 | 280 | 911 | 1827 | 865 | 3043 | 6525 | 76 | 130 | 186 |
| 87,4 | 87,4 | 91,7 | 91,7 | 49500 | 31000 | 11000 | 17000 | 405 | 1430 | 3005 | 1180 | 4305 | 9353 | 177 | 285 | 387 |
| 87,4 | 87,4 | 91,7 | 91,7 | 52000 | 31500 | 17000 | 26000 | 145 | 508 | 1059 | 431 | 1603 | 3524 | 65 | 110 | 154 |
| 87,4 | 87,4 | 91,7 | 91,7 | 49500 | 29500 | 15000 | 24000 | 192 | 769 | 1679 | 551 | 2260 | 5050 | 153 | 253 | 341 |
| 90,2 | 87,3 | 92,4 | 92,4 | 25500 | 17900 | 17000 | 26000 | 89 | 266 | 533 | 265 | 835 | 1737 | 54 | 84 | 115 |
| 90,2 | 87,3 | 92,4 | 92,4 | 23900 | 17000 | 15000 | 24000 | 144 | 431 | 863 | 415 | 1268 | 2587 | 135 | 200 | 261 |
| 90,2 | 87,3 | 92,4 | 92,4 | 24000 | 16200 | 19000 | 30000 | 99 | 298 | 597 | 285 | 868 | 1761 | 134 | 197 | 255 |
| 89,3 | 85,7 | 92,1 | 92,1 | 28000 | 17300 | 17000 | 26000 | 182 | 483 | 1017 | 536 | 1467 | 3214 | 71 | 105 | 143 |
| 89,3 | 85,7 | 92,1 | 92,1 | 26500 | 16500 | 16000 | 24000 | 261 | 685 | 1429 | 752 | 2002 | 4254 | 143 | 203 | 268 |
| 89,3 | 85,7 | 92,1 | 92,1 | 28000 | 16600 | 22000 | 32000 | 128 | 338 | 709 | 373 | 1006 | 2173 | 71 | 102 | 137 |
| 89,3 | 85,7 | 92,1 | 92,1 | 27000 | 15800 | 20000 | 30000 | 184 | 483 | 1003 | 528 | 1396 | 2943 | 144 | 202 | 263 |
| 89,3 | 85,7 | 92,1 | 92,1 | 67000 | 23200 | 22000 | 34000 | 115 | 303 | 635 | 334 | 898 | 1932 | 70 | 101 | 135 |
| 89,3 | 85,7 | 92,1 | 92,1 | 64000 | 22100 | 22000 | 32000 | 166 | 433 | 900 | 474 | 1251 | 2632 | 143 | 200 | 261 |
| 93 | 93 | 98,5 | 98,5 | 73000 | 44500 | 11000 | 18000 | 413 | 1314 | 2617 | 1278 | 4401 | 9371 | 87 | 148 | 210 |
| 93 | 93 | 98,5 | 98,5 | 70000 | 42500 | 9500 | 16000 | 615 | 2091 | 4345 | 1794 | 6306 | 13546 | 204 | 325 | 439 |
| 93 | 93 | 98,5 | 98,5 | 73000 | 42500 | 14000 | 22000 | 219 | 740 | 1524 | 653 | 2341 | 5087 | 75 | 125 | 175 |
| 93 | 93 | 98,5 | 98,5 | 70000 | 40500 | 12000 | 19000 | 308 | 1149 | 2459 | 887 | 3383 | 7409 | 180 | 290 | 388 |
| 89,3 | 89,3 | 92,2 | 92,2 | 35500 | 25500 | 12000 | 19000 | 174 | 591 | 1206 | 532 | 1954 | 4257 | 70 | 121 | 173 |
| 89,3 | 89,3 | 92,2 | 92,2 | 33500 | 24000 | 11000 | 17000 | 237 | 908 | 1955 | 686 | 2718 | 6043 | 160 | 265 | 362 |
| 89,3 | 89,3 | 92,2 | 92,2 | 36000 | 24300 | 17000 | 26000 | 84 | 321 | 686 | 249 | 1004 | 2259 | 59 | 101 | 143 |
| 89,3 | 89,3 | 92,2 | 92,2 | 34000 | 23000 | 15000 | 24000 | 95 | 459 | 1049 | 273 | 1344 | 3137 | 132 | 230 | 315 |
| 91 | 88,5 | 92,5 | 92,5 | 20300 | 15500 | 17000 | 26000 | 71 | 213 | 426 | 212 | 666 | 1385 | 52 | 82 | 112 |
| 91 | 88,5 | 92,5 | 92,5 | 19200 | 14600 | 15000 | 24000 | 113 | 338 | 676 | 325 | 992 | 2023 | 130 | 194 | 252 |
| 91 | 88,5 | 92,5 | 92,5 | 19200 | 14000 | 19000 | 30000 | 79 | 236 | 473 | 226 | 686 | 1392 | 130 | 192 | 248 |
| 89,3 | 85,7 | 92,1 | 92,1 | 28000 | 17300 | 17000 | 26000 | 182 | 483 | 1017 | 536 | 1467 | 3214 | 71 | 105 | 143 |
| 89,3 | 85,7 | 92,1 | 92,1 | 26500 | 16500 | 16000 | 24000 | 261 | 685 | 1429 | 752 | 2002 | 4254 | 143 | 203 | 268 |
| 89,3 | 85,7 | 92,1 | 92,1 | 28000 | 16600 | 22000 | 32000 | 128 | 338 | 709 | 373 | 1006 | 2173 | 71 | 102 | 137 |
| 89,3 | 85,7 | 92,1 | 92,1 | 27000 | 15800 | 20000 | 30000 | 184 | 483 | 1003 | 528 | 1396 | 2943 | 144 | 202 | 263 |
| 89,3 | 85,7 | 92,1 | 92,1 | 67000 | 23200 | 22000 | 34000 | 115 | 303 | 635 | 334 | 898 | 1932 | 70 | 101 | 135 |
| 89,3 | 85,7 | 92,1 | 92,1 | 64000 | 22100 | 22000 | 32000 | 166 | 433 | 900 | 474 | 1251 | 2632 | 143 | 200 | 261 |
| 94 | 94 | 98,8 | 98,8 | 64000 | 41000 | 11000 | 17000 | 354 | 1138 | 2277 | 1091 | 3797 | 8119 | 86 | 145 | 207 |
| 94 | 94 | 98,8 | 98,8 | 61000 | 39000 | 10000 | 15000 | 525 | 1816 | 3796 | 1528 | 5469 | 11813 | 201 | 321 | 435 |
| 94 | 94 | 98,8 | 98,8 | 65000 | 39000 | 15000 | 24000 | 186 | 640 | 1327 | 554 | 2020 | 4415 | 74 | 123 | 173 |
| 94 | 94 | 98,8 | 98,8 | 61000 | 37500 | 14000 | 22000 | 252 | 977 | 2113 | 726 | 2872 | 6354 | 175 | 284 | 383 |
| 97,3 | 94 | 99,7 | 99,7 | 30500 | 21800 | 15000 | 24000 | 106 | 317 | 633 | 315 | 991 | 2063 | 59 | 92 | 126 |
| 97,3 | 94 | 99,7 | 99,7 | 28500 | 20600 | 14000 | 22000 | 173 | 518 | 1035 | 497 | 1521 | 3103 | 148 | 220 | 286 |
| 97,3 | 94 | 99,7 | 99,7 | 28500 | 19700 | 18000 | 28000 | 117 | 352 | 704 | 336 | 1023 | 2075 | 146 | 215 | 278 |

## 2.2.2 Spindle bearings

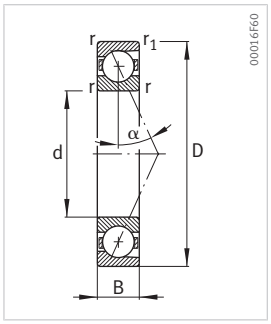
With large, medium or small balls

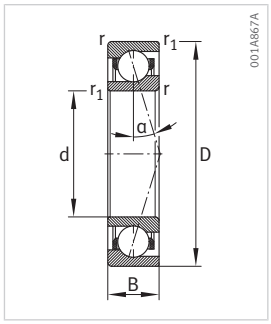
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

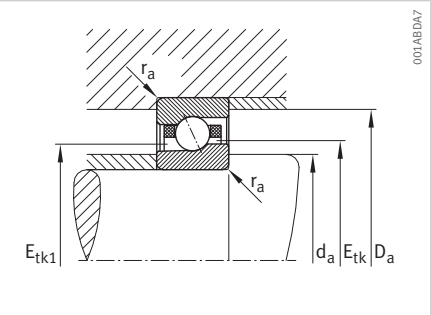
sealed



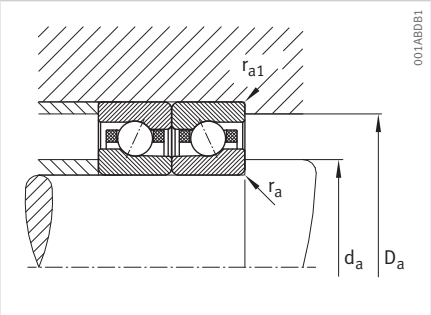




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **M7016-C-T-P4S-XL** | • | 0,87 | 80 | 125 | 22 | 1,1 | 0,6 | 17 | 88 | 117 | 1 | 0,6 |
| **M7016-E-T-P4S-XL** | • | 0,87 | 80 | 125 | 22 | 1,1 | 0,6 | 25 | 88 | 117 | 1 | 0,6 |
| **HCM7016-C-T-P4S-XL** | • | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 17 | 88 | 117 | 1 | 0,6 |
| **HCM7016-E-T-P4S-XL** | • | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 25 | 88 | 117 | 1 | 0,6 |
| **VCM7016-C-T-P4S-XL** | • | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 17 | 88 | 117 | 1 | 0,6 |
| **VCM7016-E-T-P4S-XL** | • | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 25 | 88 | 117 | 1 | 0,6 |
| **B7216-C-T-P4S** | | 1,43 | 80 | 140 | 26 | 2 | 2 | 15 | 91 | 129 | 2 | 1 |
| **B7216-E-T-P4S** | | 1,42 | 80 | 140 | 26 | 2 | 2 | 25 | 91 | 129 | 2 | 1 |
| **HCB7216-C-T-P4S** | | 1,18 | 80 | 140 | 26 | 2 | 2 | 15 | 91 | 129 | 2 | 1 |
| **HCB7216-E-T-P4S** | | 1,18 | 80 | 140 | 26 | 2 | 2 | 25 | 91 | 129 | 2 | 1 |
| **B71917-C-T-P4S** | • | 0,53 | 85 | 120 | 18 | 1,1 | 1,1 | 15 | 92 | 114 | 0,6 | 0,6 |
| **B71917-E-T-P4S** | • | 0,53 | 85 | 120 | 18 | 1,1 | 1,1 | 25 | 92 | 114 | 0,6 | 0,6 |
| **HCB71917-C-T-P4S** | • | 0,44 | 85 | 120 | 18 | 1,1 | 1,1 | 15 | 92 | 114 | 0,6 | 0,6 |
| **HCB71917-E-T-P4S** | • | 0,44 | 85 | 120 | 18 | 1,1 | 1,1 | 25 | 92 | 114 | 0,6 | 0,6 |
| **HS71917-C-T-P4S** | • | 0,572 | 85 | 120 | 18 | 1,1 | 1,1 | 15 | 92 | 114 | 0,6 | 0,6 |
| **HS71917-E-T-P4S** | • | 0,571 | 85 | 120 | 18 | 1,1 | 1,1 | 25 | 92 | 114 | 0,6 | 0,6 |
| **HC71917-E-T-P4S** | • | 0,545 | 85 | 120 | 18 | 1,1 | 1,1 | 25 | 92 | 114 | 0,6 | 0,6 |
| **M71917-C-T-P4S-XL** | • | 0,49 | 85 | 120 | 18 | 1,1 | 0,6 | 17 | 92 | 114 | 0,6 | 0,6 |
| **M71917-E-T-P4S-XL** | • | 0,49 | 85 | 120 | 18 | 1,1 | 0,6 | 25 | 92 | 114 | 0,6 | 0,6 |
| **HCM71917-C-T-P4S-XL** | • | 0,43 | 85 | 120 | 18 | 1,1 | 0,6 | 17 | 92 | 114 | 0,6 | 0,6 |
| **HCM71917-E-T-P4S-XL** | • | 0,43 | 85 | 120 | 18 | 1,1 | 0,6 | 25 | 92 | 114 | 0,6 | 0,6 |
| **VCM71917-C-T-P4S-XL** | • | 0,43 | 85 | 120 | 18 | 1,1 | 0,6 | 17 | 92 | 114 | 0,6 | 0,6 |
| **VCM71917-E-T-P4S-XL** | • | 0,43 | 85 | 120 | 18 | 1,1 | 0,6 | 25 | 92 | 114 | 0,6 | 0,6 |
| **B7017-C-T-P4S** | • | 0,88 | 85 | 130 | 22 | 1,1 | 1,1 | 15 | 93 | 122 | 1 | 0,6 |
| **B7017-E-T-P4S** | • | 0,88 | 85 | 130 | 22 | 1,1 | 1,1 | 25 | 93 | 122 | 1 | 0,6 |
| **HCB7017-C-T-P4S** | • | 0,74 | 85 | 130 | 22 | 1,1 | 1,1 | 15 | 93 | 122 | 1 | 0,6 |
| **HCB7017-E-T-P4S** | • | 0,74 | 85 | 130 | 22 | 1,1 | 1,1 | 25 | 93 | 122 | 1 | 0,6 |
| **HS7017-C-T-P4S** | • | 0,97 | 85 | 130 | 22 | 1,1 | 1,1 | 15 | 93 | 122 | 1 | 0,6 |
| **HS7017-E-T-P4S** | • | 0,969 | 85 | 130 | 22 | 1,1 | 1,1 | 25 | 93 | 122 | 1 | 0,6 |
| **HC7017-E-T-P4S** | • | 0,913 | 85 | 130 | 22 | 1,1 | 1,1 | 25 | 93 | 122 | 1 | 0,6 |
| **M7017-C-T-P4S-XL** | • | 0,92 | 85 | 130 | 22 | 1,1 | 0,6 | 17 | 93 | 122 | 1 | 0,6 |
| **M7017-E-T-P4S-XL** | • | 0,92 | 85 | 130 | 22 | 1,1 | 0,6 | 25 | 93 | 122 | 1 | 0,6 |
| **HCM7017-C-T-P4S-XL** | • | 0,85 | 85 | 130 | 22 | 1,1 | 0,6 | 17 | 93 | 122 | 1 | 0,6 |
| **HCM7017-E-T-P4S-XL** | • | 0,85 | 85 | 130 | 22 | 1,1 | 0,6 | 25 | 93 | 122 | 1 | 0,6 |
| **VCM7017-C-T-P4S-XL** | • | 0,85 | 85 | 130 | 22 | 1,1 | 0,6 | 17 | 93 | 122 | 1 | 0,6 |
| **VCM7017-E-T-P4S-XL** | • | 0,85 | 85 | 130 | 22 | 1,1 | 0,6 | 25 | 93 | 122 | 1 | 0,6 |
| **B7217-C-T-P4S** | | 1,82 | 85 | 150 | 28 | 2 | 2 | 15 | 98 | 138 | 2 | 1 |
| **B7217-E-T-P4S** | | 1,81 | 85 | 150 | 28 | 2 | 2 | 25 | 98 | 138 | 2 | 1 |
| **HCB7217-C-T-P4S** | | 1,55 | 85 | 150 | 28 | 2 | 2 | 15 | 98 | 138 | 2 | 1 |
| **HCB7217-E-T-P4S** | | 1,55 | 85 | 150 | 28 | 2 | 2 | 25 | 98 | 138 | 2 | 1 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 96,3 | 92,4 | 99,6 | 99,6 | 34000 | 22800 | 16000 | 24000 | 241 | 640 | 1353 | 715 | 1977 | 4374 | 83 | 122 | 170 |
| 96,3 | 92,4 | 99,6 | 99,6 | 32500 | 21700 | 15000 | 22000 | 345 | 907 | 1895 | 996 | 2668 | 5705 | 164 | 234 | 311 |
| 96,3 | 92,4 | 99,6 | 99,6 | 34000 | 21800 | 20000 | 30000 | 169 | 447 | 941 | 495 | 1348 | 2936 | 81 | 118 | 161 |
| 96,3 | 92,4 | 99,6 | 99,6 | 32500 | 20800 | 19000 | 28000 | 243 | 638 | 1328 | 698 | 1855 | 3929 | 164 | 231 | 304 |
| 96,3 | 92,4 | 99,6 | 99,6 | 82000 | 30500 | 20000 | 32000 | 152 | 401 | 842 | 443 | 1200 | 2604 | 81 | 117 | 158 |
| 96,3 | 92,4 | 99,6 | 99,6 | 78000 | 29000 | 20000 | 30000 | 218 | 572 | 1191 | 627 | 1661 | 3509 | 163 | 230 | 301 |
| 100,5 | 100,5 | 105,3 | 105,3 | 94000 | 55000 | 10000 | 17000 | 549 | 1721 | 3412 | 1701 | 5781 | 12250 | 94 | 159 | 226 |
| 100,5 | 100,5 | 105,3 | 105,3 | 89000 | 52000 | 9000 | 15000 | 833 | 2764 | 5699 | 2433 | 8347 | 17799 | 221 | 349 | 472 |
| 100,5 | 100,5 | 105,3 | 105,3 | 94000 | 52000 | 12000 | 19000 | 293 | 968 | 1979 | 876 | 3068 | 6618 | 82 | 134 | 187 |
| 100,5 | 100,5 | 105,3 | 105,3 | 89000 | 50000 | 11000 | 18000 | 428 | 1527 | 3225 | 1232 | 4498 | 9728 | 196 | 312 | 416 |
| 95,9 | 95,9 | 99,3 | 99,3 | 47000 | 33500 | 11000 | 17000 | 237 | 788 | 1597 | 726 | 2609 | 5644 | 80 | 136 | 195 |
| 95,9 | 95,9 | 99,3 | 99,3 | 44500 | 31500 | 10000 | 15000 | 333 | 1226 | 2609 | 968 | 3675 | 8074 | 184 | 301 | 409 |
| 95,9 | 95,9 | 99,3 | 99,3 | 47000 | 32000 | 15000 | 24000 | 117 | 428 | 906 | 346 | 1341 | 2985 | 67 | 114 | 161 |
| 95,9 | 95,9 | 99,3 | 99,3 | 44500 | 30000 | 14000 | 22000 | 143 | 627 | 1403 | 409 | 1837 | 4197 | 154 | 262 | 356 |
| 98,5 | 96 | 99,9 | 99,9 | 21200 | 17000 | 15000 | 24000 | 74 | 221 | 442 | 220 | 689 | 1433 | 56 | 87 | 119 |
| 98,5 | 96 | 99,9 | 99,9 | 20000 | 16000 | 14000 | 22000 | 117 | 352 | 704 | 338 | 1032 | 2102 | 140 | 208 | 270 |
| 98,5 | 96 | 99,9 | 99,9 | 20000 | 15300 | 18000 | 28000 | 82 | 247 | 493 | 236 | 716 | 1452 | 140 | 206 | 265 |
| 96,3 | 92,4 | 99,5 | 99,5 | 31500 | 19300 | 16000 | 24000 | 203 | 537 | 1131 | 596 | 1630 | 3569 | 74 | 108 | 148 |
| 96,3 | 92,4 | 99,5 | 99,5 | 30000 | 18400 | 15000 | 22000 | 291 | 764 | 1592 | 838 | 2230 | 4737 | 149 | 210 | 277 |
| 96,3 | 92,4 | 99,5 | 99,5 | 31500 | 18500 | 20000 | 30000 | 142 | 376 | 788 | 414 | 1118 | 2414 | 73 | 105 | 142 |
| 96,3 | 92,4 | 99,5 | 99,5 | 30000 | 17600 | 19000 | 28000 | 205 | 538 | 1118 | 588 | 1556 | 3278 | 149 | 209 | 273 |
| 96,3 | 92,4 | 99,5 | 99,5 | 75000 | 26000 | 20000 | 32000 | 128 | 337 | 706 | 371 | 998 | 2146 | 73 | 104 | 139 |
| 96,3 | 92,4 | 99,5 | 99,5 | 72000 | 24700 | 20000 | 30000 | 185 | 483 | 1003 | 528 | 1394 | 2932 | 148 | 208 | 270 |
| 99 | 99 | 103,8 | 103,8 | 66000 | 43500 | 11000 | 16000 | 367 | 1183 | 2368 | 1132 | 3942 | 8434 | 90 | 152 | 217 |
| 99 | 99 | 103,8 | 103,8 | 63000 | 41500 | 9500 | 15000 | 540 | 1874 | 3919 | 1573 | 5639 | 12184 | 209 | 336 | 454 |
| 99 | 99 | 103,8 | 103,8 | 67000 | 41500 | 15000 | 22000 | 189 | 653 | 1356 | 562 | 2058 | 4501 | 77 | 128 | 179 |
| 99 | 99 | 103,8 | 103,8 | 63000 | 39500 | 13000 | 20000 | 256 | 997 | 2159 | 736 | 2927 | 6484 | 181 | 296 | 398 |
| 102,3 | 99 | 104,7 | 104,7 | 30500 | 22700 | 15000 | 22000 | 107 | 322 | 643 | 320 | 1006 | 2093 | 60 | 94 | 129 |
| 102,3 | 99 | 104,7 | 104,7 | 29000 | 21400 | 13000 | 20000 | 173 | 518 | 1035 | 497 | 1520 | 3099 | 151 | 224 | 292 |
| 102,3 | 99 | 104,7 | 104,7 | 29000 | 20500 | 17000 | 26000 | 120 | 359 | 718 | 343 | 1042 | 2115 | 150 | 221 | 286 |
| 101,3 | 97,4 | 104,5 | 104,5 | 35500 | 24800 | 15000 | 24000 | 262 | 698 | 1476 | 780 | 2157 | 4772 | 90 | 133 | 185 |
| 101,3 | 97,4 | 104,5 | 104,5 | 33500 | 23700 | 14000 | 22000 | 376 | 988 | 2066 | 1086 | 2909 | 6220 | 178 | 254 | 337 |
| 101,3 | 97,4 | 104,5 | 104,5 | 35500 | 23800 | 19000 | 28000 | 184 | 488 | 1026 | 540 | 1470 | 3203 | 88 | 128 | 175 |
| 101,3 | 97,4 | 104,5 | 104,5 | 34000 | 22700 | 18000 | 26000 | 265 | 695 | 1448 | 761 | 2022 | 4283 | 178 | 251 | 330 |
| 101,3 | 97,4 | 104,5 | 104,5 | 85000 | 33500 | 20000 | 30000 | 165 | 437 | 918 | 483 | 1309 | 2841 | 88 | 127 | 171 |
| 101,3 | 97,4 | 104,5 | 104,5 | 81000 | 32000 | 19000 | 28000 | 238 | 624 | 1298 | 683 | 1811 | 3826 | 177 | 249 | 327 |
| 106,6 | 106,6 | 113,2 | 113,2 | 97000 | 59000 | 9000 | 15000 | 568 | 1786 | 3544 | 1759 | 5983 | 12688 | 99 | 167 | 238 |
| 106,6 | 106,6 | 113,2 | 113,2 | 93000 | 57000 | 8000 | 13000 | 864 | 2869 | 5921 | 2520 | 8657 | 18466 | 233 | 369 | 497 |
| 106,6 | 106,6 | 113,2 | 113,2 | 98000 | 57000 | 11000 | 18000 | 306 | 1012 | 2071 | 915 | 3205 | 6915 | 86 | 142 | 198 |
| 106,6 | 106,6 | 113,2 | 113,2 | 93000 | 54000 | 10000 | 17000 | 438 | 1572 | 3325 | 1262 | 4626 | 10015 | 206 | 328 | 438 |

## 2.2.2 Spindle bearings

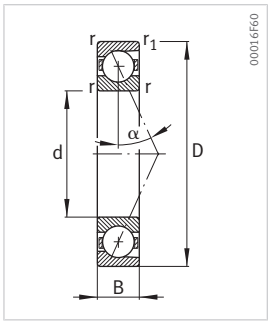
With large, medium or small balls

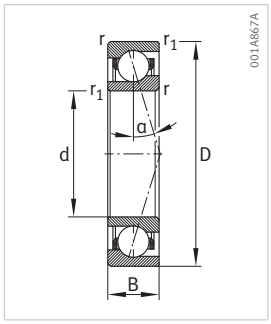
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

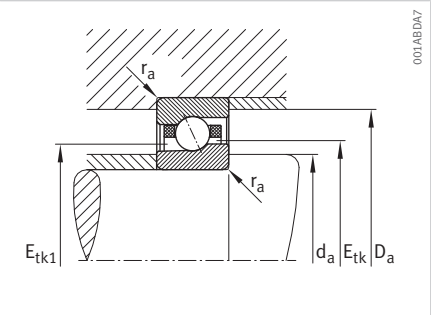
sealed



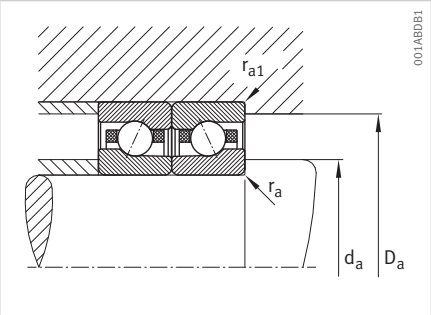




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B71918-C-T-P4S** | • | 0,55 | 90 | 125 | 18 | 1,1 | 1,1 | 15 | 97 | 119 | 0,6 | 0,6 |
| **B71918-E-T-P4S** | • | 0,55 | 90 | 125 | 18 | 1,1 | 1,1 | 25 | 97 | 119 | 0,6 | 0,6 |
| **HCB71918-C-T-P4S** | • | 0,461 | 90 | 125 | 18 | 1,1 | 1,1 | 15 | 97 | 119 | 0,6 | 0,6 |
| **HCB71918-E-T-P4S** | • | 0,462 | 90 | 125 | 18 | 1,1 | 1,1 | 25 | 97 | 119 | 0,6 | 0,6 |
| **HS71918-C-T-P4S** | • | 0,58 | 90 | 125 | 18 | 1,1 | 1,1 | 15 | 97 | 119 | 0,6 | 0,6 |
| **HS71918-E-T-P4S** | • | 0,579 | 90 | 125 | 18 | 1,1 | 1,1 | 25 | 97 | 119 | 0,6 | 0,6 |
| **HC71918-E-T-P4S** | • | 0,564 | 90 | 125 | 18 | 1,1 | 1,1 | 25 | 97 | 119 | 0,6 | 0,6 |
| **M71918-C-T-P4S-XL** | • | 0,52 | 90 | 125 | 18 | 1,1 | 0,6 | 17 | 97 | 119 | 0,6 | 0,6 |
| **M71918-E-T-P4S-XL** | • | 0,52 | 90 | 125 | 18 | 1,1 | 0,6 | 25 | 97 | 119 | 0,6 | 0,6 |
| **HCM71918-C-T-P4S-XL** | • | 0,45 | 90 | 125 | 18 | 1,1 | 0,6 | 17 | 97 | 119 | 0,6 | 0,6 |
| **HCM71918-E-T-P4S-XL** | • | 0,45 | 90 | 125 | 18 | 1,1 | 0,6 | 25 | 97 | 119 | 0,6 | 0,6 |
| **VCM71918-C-T-P4S-XL** | • | 0,45 | 90 | 125 | 18 | 1,1 | 0,6 | 17 | 97 | 119 | 0,6 | 0,6 |
| **VCM71918-E-T-P4S-XL** | • | 0,45 | 90 | 125 | 18 | 1,1 | 0,6 | 25 | 97 | 119 | 0,6 | 0,6 |
| **B7018-C-T-P4S** | • | 1,14 | 90 | 140 | 24 | 1,5 | 1,5 | 15 | 100 | 131 | 1,5 | 0,6 |
| **B7018-E-T-P4S** | • | 1,14 | 90 | 140 | 24 | 1,5 | 1,5 | 25 | 100 | 131 | 1,5 | 0,6 |
| **HCB7018-C-T-P4S** | • | 0,95 | 90 | 140 | 24 | 1,5 | 1,5 | 15 | 100 | 131 | 1,5 | 0,6 |
| **HCB7018-E-T-P4S** | • | 0,95 | 90 | 140 | 24 | 1,5 | 1,5 | 25 | 100 | 131 | 1,5 | 0,6 |
| **HS7018-C-T-P4S** | • | 1,27 | 90 | 140 | 24 | 1,5 | 1,5 | 15 | 100 | 131 | 1,5 | 0,6 |
| **HS7018-E-T-P4S** | • | 1,27 | 90 | 140 | 24 | 1,5 | 1,5 | 25 | 100 | 131 | 1,5 | 0,6 |
| **HC7018-E-T-P4S** | • | 1,19 | 90 | 140 | 24 | 1,5 | 1,5 | 25 | 100 | 131 | 1,5 | 0,6 |
| **M7018-C-T-P4S-XL** | • | 1,2 | 90 | 140 | 24 | 1,5 | 1 | 17 | 100 | 131 | 1,5 | 0,6 |
| **M7018-E-T-P4S-XL** | • | 1,2 | 90 | 140 | 24 | 1,5 | 1 | 25 | 100 | 131 | 1,5 | 0,6 |
| **HCM7018-C-T-P4S-XL** | • | 1,1 | 90 | 140 | 24 | 1,5 | 1 | 17 | 100 | 131 | 1,5 | 0,6 |
| **HCM7018-E-T-P4S-XL** | • | 1,1 | 90 | 140 | 24 | 1,5 | 1 | 25 | 100 | 131 | 1,5 | 0,6 |
| **VCM7018-C-T-P4S-XL** | • | 1,1 | 90 | 140 | 24 | 1,5 | 1 | 17 | 100 | 131 | 1,5 | 0,6 |
| **VCM7018-E-T-P4S-XL** | • | 1,1 | 90 | 140 | 24 | 1,5 | 1 | 25 | 100 | 131 | 1,5 | 0,6 |
| **B7218-C-T-P4S** | | 2,2 | 90 | 160 | 30 | 2 | 2 | 15 | 104 | 147 | 2 | 1 |
| **B7218-E-T-P4S** | | 2,19 | 90 | 160 | 30 | 2 | 2 | 25 | 104 | 147 | 2 | 1 |
| **HCB7218-C-T-P4S** | | 1,8 | 90 | 160 | 30 | 2 | 2 | 15 | 104 | 147 | 2 | 1 |
| **HCB7218-E-T-P4S** | | 1,79 | 90 | 160 | 30 | 2 | 2 | 25 | 104 | 147 | 2 | 1 |
| **B71919-C-T-P4S** | • | 0,58 | 95 | 130 | 18 | 1,1 | 1,1 | 15 | 102 | 124 | 0,6 | 0,6 |
| **B71919-E-T-P4S** | • | 0,58 | 95 | 130 | 18 | 1,1 | 1,1 | 25 | 102 | 124 | 0,6 | 0,6 |
| **HCB71919-C-T-P4S** | • | 0,482 | 95 | 130 | 18 | 1,1 | 1,1 | 15 | 102 | 124 | 0,6 | 0,6 |
| **HCB71919-E-T-P4S** | • | 0,483 | 95 | 130 | 18 | 1,1 | 1,1 | 25 | 102 | 124 | 0,6 | 0,6 |
| **HS71919-C-T-P4S** | • | 0,606 | 95 | 130 | 18 | 1,1 | 1,1 | 15 | 102 | 124 | 0,6 | 0,6 |
| **HS71919-E-T-P4S** | • | 0,605 | 95 | 130 | 18 | 1,1 | 1,1 | 25 | 102 | 124 | 0,6 | 0,6 |
| **HC71919-E-T-P4S** | • | 0,59 | 95 | 130 | 18 | 1,1 | 1,1 | 25 | 102 | 124 | 0,6 | 0,6 |
| **M71919-C-T-P4S-XL** | • | 0,54 | 95 | 130 | 18 | 1,1 | 0,6 | 17 | 102 | 124 | 0,6 | 0,6 |
| **M71919-E-T-P4S-XL** | • | 0,54 | 95 | 130 | 18 | 1,1 | 0,6 | 25 | 102 | 124 | 0,6 | 0,6 |
| **HCM71919-C-T-P4S-XL** | • | 0,47 | 95 | 130 | 18 | 1,1 | 0,6 | 17 | 102 | 124 | 0,6 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 100,9 | 100,9 | 104,3 | 104,3 | 48000 | 35000 | 11000 | 16000 | 238 | 796 | 1615 | 729 | 2628 | 5691 | 82 | 140 | 200 |
| 100,9 | 100,9 | 104,3 | 104,3 | 45000 | 33000 | 9500 | 15000 | 334 | 1236 | 2634 | 970 | 3701 | 8140 | 189 | 309 | 420 |
| 100,9 | 100,9 | 104,3 | 104,3 | 48000 | 33500 | 15000 | 22000 | 118 | 434 | 919 | 349 | 1357 | 3023 | 69 | 118 | 165 |
| 100,9 | 100,9 | 104,3 | 104,3 | 45500 | 31500 | 13000 | 20000 | 147 | 648 | 1450 | 421 | 1897 | 4337 | 160 | 272 | 369 |
| 103,2 | 100,6 | 104,8 | 104,8 | 23200 | 18700 | 15000 | 22000 | 79 | 237 | 474 | 235 | 739 | 1536 | 57 | 89 | 122 |
| 103,2 | 100,6 | 104,8 | 104,8 | 21900 | 17700 | 13000 | 20000 | 129 | 386 | 773 | 371 | 1133 | 2309 | 144 | 214 | 279 |
| 103,2 | 100,6 | 104,8 | 104,8 | 22000 | 16900 | 17000 | 26000 | 90 | 269 | 538 | 257 | 781 | 1584 | 144 | 212 | 273 |
| 101,3 | 97,4 | 104,4 | 104,4 | 33000 | 21000 | 15000 | 24000 | 221 | 585 | 1233 | 650 | 1778 | 3894 | 80 | 117 | 161 |
| 101,3 | 97,4 | 104,4 | 104,4 | 31000 | 20100 | 14000 | 22000 | 317 | 832 | 1736 | 913 | 2431 | 5164 | 161 | 228 | 301 |
| 101,3 | 97,4 | 104,4 | 104,4 | 33000 | 20100 | 19000 | 28000 | 155 | 410 | 859 | 452 | 1220 | 2633 | 80 | 114 | 154 |
| 101,3 | 97,4 | 104,4 | 104,4 | 31500 | 19200 | 18000 | 26000 | 224 | 586 | 1219 | 641 | 1696 | 3574 | 162 | 227 | 296 |
| 101,3 | 97,4 | 104,4 | 104,4 | 79000 | 28000 | 20000 | 30000 | 139 | 367 | 769 | 405 | 1089 | 2341 | 79 | 113 | 151 |
| 101,3 | 97,4 | 104,4 | 104,4 | 75000 | 27000 | 19000 | 28000 | 201 | 526 | 1093 | 575 | 1520 | 3196 | 161 | 225 | 294 |
| 105,5 | 105,5 | 110,9 | 110,9 | 78000 | 51000 | 10000 | 15000 | 437 | 1395 | 2785 | 1347 | 4651 | 9920 | 95 | 161 | 229 |
| 105,5 | 105,5 | 110,9 | 110,9 | 74000 | 48500 | 9000 | 14000 | 646 | 2205 | 4590 | 1880 | 6636 | 14269 | 223 | 355 | 479 |
| 105,5 | 105,5 | 110,9 | 110,9 | 78000 | 49000 | 14000 | 22000 | 230 | 781 | 1613 | 685 | 2464 | 5361 | 82 | 136 | 191 |
| 105,5 | 105,5 | 110,9 | 110,9 | 74000 | 46500 | 12000 | 19000 | 319 | 1201 | 2577 | 916 | 3528 | 7745 | 195 | 316 | 423 |
| 109,3 | 105,7 | 111,9 | 111,9 | 36000 | 26500 | 14000 | 22000 | 126 | 377 | 754 | 375 | 1178 | 2451 | 65 | 102 | 140 |
| 109,3 | 105,7 | 111,9 | 111,9 | 34000 | 25000 | 12000 | 19000 | 204 | 612 | 1225 | 588 | 1799 | 3667 | 164 | 244 | 318 |
| 109,3 | 105,7 | 111,9 | 111,9 | 34000 | 24000 | 16000 | 24000 | 141 | 423 | 845 | 404 | 1228 | 2490 | 163 | 241 | 310 |
| 108,3 | 104,1 | 111,7 | 111,7 | 39500 | 27500 | 14000 | 22000 | 291 | 775 | 1639 | 866 | 2395 | 5299 | 93 | 137 | 191 |
| 108,3 | 104,1 | 111,7 | 111,7 | 37500 | 26000 | 14000 | 20000 | 418 | 1098 | 2295 | 1207 | 3232 | 6910 | 184 | 262 | 349 |
| 108,3 | 104,1 | 111,7 | 111,7 | 39500 | 26500 | 18000 | 26000 | 205 | 542 | 1140 | 599 | 1632 | 3557 | 91 | 133 | 181 |
| 108,3 | 104,1 | 111,7 | 111,7 | 37500 | 25000 | 17000 | 24000 | 295 | 772 | 1608 | 846 | 2247 | 4759 | 184 | 260 | 341 |
| 108,3 | 104,1 | 111,7 | 111,7 | 95000 | 37000 | 18000 | 28000 | 184 | 485 | 1020 | 536 | 1454 | 3155 | 91 | 131 | 177 |
| 108,3 | 104,1 | 111,7 | 111,7 | 90000 | 35000 | 17000 | 26000 | 265 | 693 | 1443 | 759 | 2012 | 4250 | 183 | 258 | 338 |
| 112,1 | 112,1 | 120 | 120 | 125000 | 75000 | 8500 | 14000 | 732 | 2280 | 4513 | 2267 | 7640 | 16156 | 109 | 183 | 260 |
| 112,1 | 112,1 | 120 | 120 | 119000 | 72000 | 7500 | 12000 | 1127 | 3689 | 7575 | 3291 | 11132 | 23627 | 257 | 404 | 545 |
| 112,1 | 112,1 | 120 | 120 | 125000 | 72000 | 11000 | 18000 | 400 | 1303 | 2655 | 1197 | 4129 | 8866 | 95 | 156 | 217 |
| 112,1 | 112,1 | 120 | 120 | 119000 | 69000 | 9000 | 15000 | 586 | 2042 | 4283 | 1688 | 6013 | 12905 | 230 | 361 | 481 |
| 105,9 | 105,9 | 109,2 | 109,2 | 48500 | 36500 | 10000 | 16000 | 243 | 813 | 1651 | 743 | 2679 | 5806 | 84 | 144 | 206 |
| 105,9 | 105,9 | 109,2 | 109,2 | 46000 | 34500 | 9000 | 14000 | 341 | 1262 | 2693 | 988 | 3777 | 8313 | 196 | 319 | 434 |
| 105,9 | 105,9 | 109,2 | 109,2 | 49000 | 35000 | 14000 | 22000 | 119 | 440 | 932 | 352 | 1373 | 3061 | 71 | 121 | 170 |
| 105,9 | 105,9 | 109,2 | 109,2 | 46000 | 33000 | 13000 | 19000 | 148 | 656 | 1470 | 423 | 1918 | 4393 | 164 | 280 | 380 |
| 108,2 | 105,6 | 109,7 | 109,7 | 23900 | 19900 | 14000 | 22000 | 82 | 246 | 492 | 244 | 766 | 1593 | 60 | 94 | 127 |
| 108,2 | 105,6 | 109,7 | 109,7 | 22500 | 18700 | 13000 | 19000 | 131 | 393 | 787 | 377 | 1153 | 2347 | 150 | 223 | 290 |
| 108,2 | 105,6 | 109,7 | 109,7 | 22500 | 17900 | 16000 | 24000 | 92 | 276 | 552 | 263 | 801 | 1623 | 150 | 221 | 285 |
| 106,3 | 102,4 | 109,3 | 109,3 | 33500 | 22000 | 15000 | 22000 | 231 | 611 | 1288 | 679 | 1858 | 4069 | 84 | 122 | 168 |
| 106,3 | 102,4 | 109,3 | 109,3 | 31500 | 21000 | 14000 | 20000 | 331 | 869 | 1812 | 953 | 2539 | 5393 | 168 | 237 | 313 |
| 106,3 | 102,4 | 109,3 | 109,3 | 33500 | 21000 | 18000 | 26000 | 162 | 428 | 898 | 472 | 1275 | 2752 | 83 | 119 | 160 |

## 2.2.2 Spindle bearings

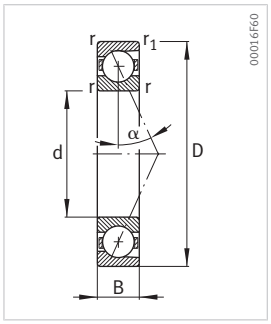
With large, medium or small balls

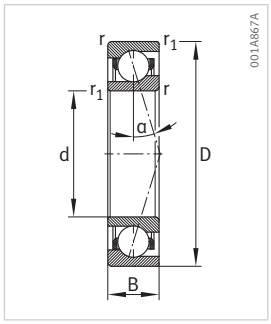
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

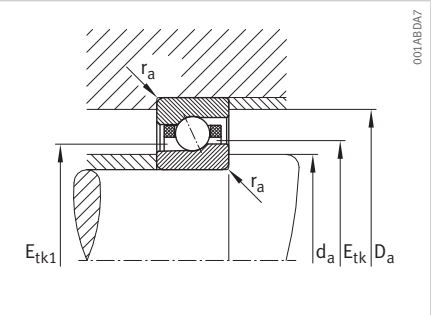
sealed



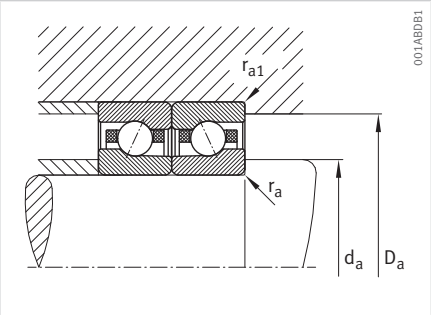




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCM71919-E-T-P4S-XL** | • | 0,47 | 95 | 130 | 18 | 1,1 | 0,6 | 25 | 102 | 124 | 0,6 | 0,6 |
| **VCM71919-C-T-P4S-XL** | • | 0,47 | 95 | 130 | 18 | 1,1 | 0,6 | 17 | 102 | 124 | 0,6 | 0,6 |
| **VCM71919-E-T-P4S-XL** | • | 0,47 | 95 | 130 | 18 | 1,1 | 0,6 | 25 | 102 | 124 | 0,6 | 0,6 |
| **B7019-C-T-P4S** | • | 1,19 | 95 | 145 | 24 | 1,5 | 1,5 | 15 | 105 | 136 | 1,5 | 0,6 |
| **B7019-E-T-P4S** | • | 1,19 | 95 | 145 | 24 | 1,5 | 1,5 | 25 | 105 | 136 | 1,5 | 0,6 |
| **HCB7019-C-T-P4S** | • | 1 | 95 | 145 | 24 | 1,5 | 1,5 | 15 | 105 | 136 | 1,5 | 0,6 |
| **HCB7019-E-T-P4S** | • | 1 | 95 | 145 | 24 | 1,5 | 1,5 | 25 | 105 | 136 | 1,5 | 0,6 |
| **HS7019-C-T-P4S** | • | 1,32 | 95 | 145 | 24 | 1,5 | 1,5 | 15 | 105 | 136 | 1,5 | 0,6 |
| **HS7019-E-T-P4S** | • | 1,32 | 95 | 145 | 24 | 1,5 | 1,5 | 25 | 105 | 136 | 1,5 | 0,6 |
| **HC7019-E-T-P4S** | • | 1,24 | 95 | 145 | 24 | 1,5 | 1,5 | 25 | 105 | 136 | 1,5 | 0,6 |
| **M7019-C-T-P4S-XL** | • | 1,3 | 95 | 145 | 24 | 1,5 | 1 | 17 | 105 | 136 | 1,5 | 0,6 |
| **M7019-E-T-P4S-XL** | • | 1,3 | 95 | 145 | 24 | 1,5 | 1 | 25 | 105 | 136 | 1,5 | 0,6 |
| **HCM7019-C-T-P4S-XL** | • | 1,2 | 95 | 145 | 24 | 1,5 | 1 | 17 | 105 | 136 | 1,5 | 0,6 |
| **HCM7019-E-T-P4S-XL** | • | 1,2 | 95 | 145 | 24 | 1,5 | 1 | 25 | 105 | 136 | 1,5 | 0,6 |
| **VCM7019-C-T-P4S-XL** | • | 1,2 | 95 | 145 | 24 | 1,5 | 1 | 17 | 105 | 136 | 1,5 | 0,6 |
| **VCM7019-E-T-P4S-XL** | • | 1,2 | 95 | 145 | 24 | 1,5 | 1 | 25 | 105 | 136 | 1,5 | 0,6 |
| **B7219-C-T-P4S** | | 2,73 | 95 | 170 | 32 | 2,1 | 2,1 | 15 | 110,5 | 154 | 2,1 | 1 |
| **B7219-E-T-P4S** | | 2,72 | 95 | 170 | 32 | 2,1 | 2,1 | 25 | 110,5 | 154 | 2,1 | 1 |
| **HCB7219-C-T-P4S** | | 2,3 | 95 | 170 | 32 | 2,1 | 2,1 | 15 | 110,5 | 154 | 2,1 | 1 |
| **HCB7219-E-T-P4S** | | 2,29 | 95 | 170 | 32 | 2,1 | 2,1 | 25 | 110,5 | 154 | 2,1 | 1 |
| **B71920-C-T-P4S** | • | 0,78 | 100 | 140 | 20 | 1,1 | 1,1 | 15 | 107 | 133 | 0,6 | 0,6 |
| **B71920-E-T-P4S** | • | 0,78 | 100 | 140 | 20 | 1,1 | 1,1 | 25 | 107 | 133 | 0,6 | 0,6 |
| **HCB71920-C-T-P4S** | • | 0,65 | 100 | 140 | 20 | 1,1 | 1,1 | 15 | 107 | 133 | 0,6 | 0,6 |
| **HCB71920-E-T-P4S** | • | 0,65 | 100 | 140 | 20 | 1,1 | 1,1 | 25 | 107 | 133 | 0,6 | 0,6 |
| **HS71920-C-T-P4S** | • | 0,86 | 100 | 140 | 20 | 1,1 | 1,1 | 15 | 107 | 133 | 0,6 | 0,6 |
| **HS71920-E-T-P4S** | • | 0,86 | 100 | 140 | 20 | 1,1 | 1,1 | 25 | 107 | 133 | 0,6 | 0,6 |
| **HC71920-E-T-P4S** | • | 0,81 | 100 | 140 | 20 | 1,1 | 1,1 | 25 | 107 | 133 | 0,6 | 0,6 |
| **M71920-C-T-P4S-XL** | • | 0,76 | 100 | 140 | 20 | 1,1 | 0,6 | 17 | 107 | 133 | 0,6 | 0,6 |
| **M71920-E-T-P4S-XL** | • | 0,76 | 100 | 140 | 20 | 1,1 | 0,6 | 25 | 107 | 133 | 0,6 | 0,6 |
| **HCM71920-C-T-P4S-XL** | • | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 17 | 107 | 133 | 0,6 | 0,6 |
| **HCM71920-E-T-P4S-XL** | • | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 25 | 107 | 133 | 0,6 | 0,6 |
| **VCM71920-C-T-P4S-XL** | • | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 17 | 107 | 133 | 0,6 | 0,6 |
| **VCM71920-E-T-P4S-XL** | • | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 25 | 107 | 133 | 0,6 | 0,6 |
| **B7020-C-T-P4S** | • | 1,24 | 100 | 150 | 24 | 1,5 | 1,5 | 15 | 110 | 141 | 1,5 | 0,6 |
| **B7020-E-T-P4S** | • | 1,24 | 100 | 150 | 24 | 1,5 | 1,5 | 25 | 110 | 141 | 1,5 | 0,6 |
| **HCB7020-C-T-P4S** | • | 1,03 | 100 | 150 | 24 | 1,5 | 1,5 | 15 | 110 | 141 | 1,5 | 0,6 |
| **HCB7020-E-T-P4S** | • | 1,03 | 100 | 150 | 24 | 1,5 | 1,5 | 25 | 110 | 141 | 1,5 | 0,6 |
| **HS7020-C-T-P4S** | • | 1,38 | 100 | 150 | 24 | 1,5 | 1,5 | 15 | 110 | 141 | 1,5 | 0,6 |
| **HS7020-E-T-P4S** | • | 1,38 | 100 | 150 | 24 | 1,5 | 1,5 | 25 | 110 | 141 | 1,5 | 0,6 |
| **HC7020-E-T-P4S** | • | 1,29 | 100 | 150 | 24 | 1,5 | 1,5 | 25 | 110 | 141 | 1,5 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 106,3 | 102,4 | 109,3 | 109,3 | 32000 | 20100 | 17000 | 24000 | 234 | 612 | 1272 | 670 | 1771 | 3732 | 168 | 236 | 308 |
| 106,3 | 102,4 | 109,3 | 109,3 | 80000 | 29500 | 19000 | 28000 | 146 | 384 | 804 | 423 | 1137 | 2446 | 82 | 118 | 158 |
| 106,3 | 102,4 | 109,3 | 109,3 | 76000 | 28000 | 18000 | 26000 | 210 | 550 | 1142 | 601 | 1587 | 3338 | 167 | 234 | 305 |
| 110,5 | 110,5 | 115,8 | 115,8 | 81000 | 54000 | 9500 | 15000 | 444 | 1421 | 2842 | 1367 | 4726 | 10091 | 99 | 167 | 237 |
| 110,5 | 110,5 | 115,8 | 115,8 | 77000 | 52000 | 8500 | 13000 | 671 | 2295 | 4780 | 1955 | 6904 | 14849 | 233 | 372 | 502 |
| 110,5 | 110,5 | 115,8 | 115,8 | 81000 | 52000 | 13000 | 20000 | 233 | 794 | 1643 | 693 | 2499 | 5442 | 85 | 141 | 197 |
| 110,5 | 110,5 | 115,8 | 115,8 | 77000 | 49500 | 12000 | 18000 | 322 | 1220 | 2622 | 924 | 3581 | 7871 | 203 | 328 | 439 |
| 114,3 | 110,7 | 116,8 | 116,8 | 36500 | 27500 | 13000 | 20000 | 127 | 382 | 764 | 380 | 1192 | 2480 | 67 | 105 | 143 |
| 114,3 | 110,7 | 116,8 | 116,8 | 34000 | 26000 | 12000 | 18000 | 204 | 612 | 1225 | 588 | 1797 | 3663 | 168 | 249 | 324 |
| 114,3 | 110,7 | 116,8 | 116,8 | 34500 | 25000 | 15000 | 24000 | 141 | 423 | 845 | 404 | 1227 | 2488 | 167 | 246 | 317 |
| 113,3 | 109,1 | 116,7 | 116,7 | 42000 | 31000 | 14000 | 20000 | 328 | 874 | 1846 | 975 | 2699 | 5972 | 104 | 154 | 215 |
| 113,3 | 109,1 | 116,7 | 116,7 | 40000 | 29500 | 13000 | 19000 | 470 | 1236 | 2584 | 1359 | 3640 | 7782 | 207 | 295 | 392 |
| 113,3 | 109,1 | 116,7 | 116,7 | 42000 | 29500 | 17000 | 24000 | 231 | 610 | 1284 | 675 | 1839 | 4007 | 102 | 149 | 203 |
| 113,3 | 109,1 | 116,7 | 116,7 | 40000 | 28500 | 16000 | 24000 | 332 | 869 | 1811 | 952 | 2530 | 5359 | 207 | 292 | 383 |
| 113,3 | 109,1 | 116,7 | 116,7 | 101000 | 41500 | 17000 | 26000 | 207 | 547 | 1149 | 604 | 1638 | 3555 | 102 | 147 | 199 |
| 113,3 | 109,1 | 116,7 | 116,7 | 97000 | 39500 | 17000 | 24000 | 298 | 780 | 1624 | 854 | 2265 | 4786 | 206 | 289 | 379 |
| 119,1 | 119,1 | 126,9 | 126,9 | 130000 | 81000 | 8000 | 13000 | 760 | 2373 | 4703 | 2353 | 7935 | 16792 | 115 | 193 | 273 |
| 119,1 | 119,1 | 126,9 | 126,9 | 124000 | 78000 | 7000 | 11000 | 1184 | 3876 | 7964 | 3454 | 11693 | 24820 | 273 | 429 | 577 |
| 119,1 | 119,1 | 126,9 | 126,9 | 130000 | 78000 | 10000 | 17000 | 413 | 1348 | 2748 | 1234 | 4261 | 9153 | 100 | 164 | 228 |
| 119,1 | 119,1 | 126,9 | 126,9 | 124000 | 74000 | 8500 | 14000 | 605 | 2113 | 4437 | 1741 | 6219 | 13355 | 242 | 381 | 507 |
| 113,4 | 113,4 | 117,5 | 117,5 | 60000 | 45000 | 9500 | 14000 | 316 | 1040 | 2101 | 968 | 3432 | 7399 | 94 | 160 | 228 |
| 113,4 | 113,4 | 117,5 | 117,5 | 57000 | 42500 | 8500 | 13000 | 450 | 1616 | 3417 | 1305 | 4839 | 10556 | 219 | 353 | 479 |
| 113,4 | 113,4 | 117,5 | 117,5 | 60000 | 43000 | 13000 | 20000 | 160 | 572 | 1201 | 473 | 1789 | 3950 | 80 | 135 | 189 |
| 113,4 | 113,4 | 117,5 | 117,5 | 57000 | 40500 | 12000 | 18000 | 204 | 850 | 1876 | 584 | 2489 | 5611 | 187 | 311 | 421 |
| 115,2 | 112,3 | 116,9 | 116,9 | 28500 | 23500 | 13000 | 20000 | 97 | 291 | 583 | 289 | 906 | 1883 | 65 | 101 | 137 |
| 115,2 | 112,3 | 116,9 | 116,9 | 27000 | 22100 | 12000 | 18000 | 158 | 474 | 949 | 455 | 1390 | 2832 | 163 | 242 | 314 |
| 115,2 | 112,3 | 116,9 | 116,9 | 27000 | 21200 | 15000 | 24000 | 109 | 328 | 656 | 313 | 951 | 1927 | 162 | 239 | 307 |
| 113,3 | 109,1 | 116,6 | 116,6 | 38500 | 25500 | 14000 | 20000 | 269 | 714 | 1506 | 793 | 2172 | 4759 | 90 | 132 | 181 |
| 113,3 | 109,1 | 116,6 | 116,6 | 36500 | 24500 | 13000 | 19000 | 387 | 1016 | 2118 | 1114 | 2967 | 6305 | 181 | 256 | 338 |
| 113,3 | 109,1 | 116,6 | 116,6 | 38500 | 24600 | 17000 | 24000 | 190 | 500 | 1049 | 551 | 1489 | 3217 | 89 | 129 | 173 |
| 113,3 | 109,1 | 116,6 | 116,6 | 36500 | 23500 | 16000 | 24000 | 273 | 715 | 1487 | 782 | 2070 | 4362 | 182 | 255 | 333 |
| 113,3 | 109,1 | 116,6 | 116,6 | 92000 | 34500 | 17000 | 26000 | 170 | 448 | 939 | 494 | 1329 | 2860 | 89 | 127 | 170 |
| 113,3 | 109,1 | 116,6 | 116,6 | 88000 | 33000 | 17000 | 24000 | 245 | 642 | 1334 | 702 | 1855 | 3901 | 181 | 253 | 330 |
| 115,5 | 115,5 | 120,8 | 120,8 | 83000 | 57000 | 9000 | 14000 | 464 | 1484 | 2970 | 1427 | 4935 | 10539 | 104 | 175 | 248 |
| 115,5 | 115,5 | 120,8 | 120,8 | 79000 | 55000 | 8000 | 13000 | 681 | 2336 | 4869 | 1982 | 7018 | 15103 | 242 | 385 | 521 |
| 115,5 | 115,5 | 120,8 | 120,8 | 83000 | 55000 | 13000 | 19000 | 241 | 823 | 1703 | 717 | 2587 | 5636 | 89 | 148 | 206 |
| 115,5 | 115,5 | 120,8 | 120,8 | 79000 | 52000 | 11000 | 17000 | 333 | 1266 | 2723 | 957 | 3715 | 8170 | 212 | 343 | 459 |
| 119,3 | 115,7 | 121,8 | 121,8 | 36500 | 28500 | 13000 | 19000 | 127 | 382 | 764 | 379 | 1190 | 2476 | 68 | 107 | 145 |
| 119,3 | 115,7 | 121,8 | 121,8 | 34500 | 27000 | 11000 | 17000 | 207 | 621 | 1242 | 596 | 1822 | 3713 | 172 | 256 | 333 |
| 119,3 | 115,7 | 121,8 | 121,8 | 34500 | 26000 | 15000 | 22000 | 144 | 431 | 863 | 412 | 1252 | 2539 | 171 | 253 | 326 |

## 2.2.2 Spindle bearings

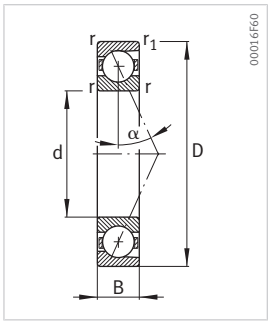
With large, medium or small balls

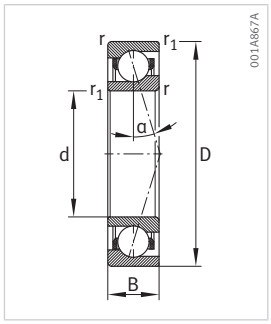
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

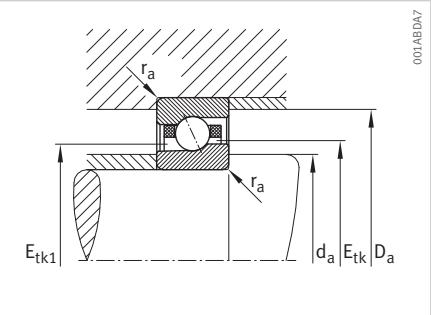
sealed



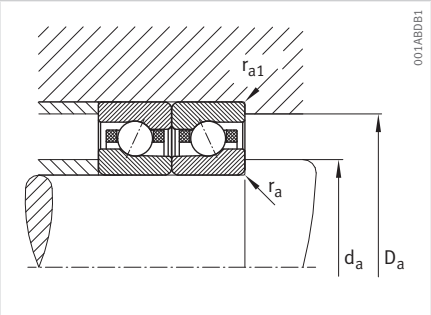




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **M7020-C-T-P4S-XL** | • | 1,3 | 100 | 150 | 24 | 1,5 | 1 | 17 | 110 | 141 | 1,5 | 0,6 |
| **M7020-E-T-P4S-XL** | • | 1,3 | 100 | 150 | 24 | 1,5 | 1 | 25 | 110 | 141 | 1,5 | 0,6 |
| **HCM7020-C-T-P4S-XL** | • | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 17 | 110 | 141 | 1,5 | 0,6 |
| **HCM7020-E-T-P4S-XL** | • | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 25 | 110 | 141 | 1,5 | 0,6 |
| **VCM7020-C-T-P4S-XL** | • | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 17 | 110 | 141 | 1,5 | 0,6 |
| **VCM7020-E-T-P4S-XL** | • | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 25 | 110 | 141 | 1,5 | 0,6 |
| **B7220-C-T-P4S** | | 3,35 | 100 | 180 | 34 | 2,1 | 2,1 | 15 | 114,5 | 165,5 | 2,1 | 1 |
| **B7220-E-T-P4S** | | 3,34 | 100 | 180 | 34 | 2,1 | 2,1 | 25 | 114,5 | 165,5 | 2,1 | 1 |
| **HCB7220-C-T-P4S** | | 2,89 | 100 | 180 | 34 | 2,1 | 2,1 | 15 | 114,5 | 165,5 | 2,1 | 1 |
| **HCB7220-E-T-P4S** | | 2,88 | 100 | 180 | 34 | 2,1 | 2,1 | 25 | 114,5 | 165,5 | 2,1 | 1 |
| **B71921-C-T-P4S** | • | 0,81 | 105 | 145 | 20 | 1,1 | 1,1 | 15 | 112 | 138 | 0,6 | 0,6 |
| **B71921-E-T-P4S** | • | 0,81 | 105 | 145 | 20 | 1,1 | 1,1 | 25 | 112 | 138 | 0,6 | 0,6 |
| **HCB71921-C-T-P4S** | • | 0,69 | 105 | 145 | 20 | 1,1 | 1,1 | 15 | 112 | 138 | 0,6 | 0,6 |
| **HCB71921-E-T-P4S** | • | 0,69 | 105 | 145 | 20 | 1,1 | 1,1 | 25 | 112 | 138 | 0,6 | 0,6 |
| **HS71921-C-T-P4S** | • | 0,89 | 105 | 145 | 20 | 1,1 | 1,1 | 15 | 112 | 138 | 0,6 | 0,6 |
| **HS71921-E-T-P4S** | • | 0,89 | 105 | 145 | 20 | 1,1 | 1,1 | 25 | 112 | 138 | 0,6 | 0,6 |
| **HC71921-E-T-P4S** | • | 0,83 | 105 | 145 | 20 | 1,1 | 1,1 | 25 | 112 | 138 | 0,6 | 0,6 |
| **M71921-C-T-P4S-XL** | • | 0,79 | 105 | 145 | 20 | 1,1 | 0,6 | 17 | 112 | 138 | 0,6 | 0,6 |
| **M71921-E-T-P4S-XL** | • | 0,79 | 105 | 145 | 20 | 1,1 | 0,6 | 25 | 112 | 138 | 0,6 | 0,6 |
| **HCM71921-C-T-P4S-XL** | • | 0,69 | 105 | 145 | 20 | 1,1 | 0,6 | 17 | 112 | 138 | 0,6 | 0,6 |
| **HCM71921-E-T-P4S-XL** | • | 0,69 | 105 | 145 | 20 | 1,1 | 0,6 | 25 | 112 | 138 | 0,6 | 0,6 |
| **VCM71921-C-T-P4S-XL** | • | 0,69 | 105 | 145 | 20 | 1,1 | 0,6 | 17 | 112 | 138 | 0,6 | 0,6 |
| **VCM71921-E-T-P4S-XL** | • | 0,69 | 105 | 145 | 20 | 1,1 | 0,6 | 25 | 112 | 138 | 0,6 | 0,6 |
| **B7021-C-T-P4S** | • | 1,6 | 105 | 160 | 26 | 2 | 2 | 15 | 116 | 150 | 2 | 1 |
| **B7021-E-T-P4S** | • | 1,6 | 105 | 160 | 26 | 2 | 2 | 25 | 116 | 150 | 2 | 1 |
| **HCB7021-C-T-P4S** | • | 1,39 | 105 | 160 | 26 | 2 | 2 | 15 | 116 | 150 | 2 | 1 |
| **HCB7021-E-T-P4S** | • | 1,39 | 105 | 160 | 26 | 2 | 2 | 25 | 116 | 150 | 2 | 1 |
| **HS7021-C-T-P4S** | • | 1,7 | 105 | 160 | 26 | 2 | 2 | 15 | 116 | 150 | 2 | 1 |
| **HS7021-E-T-P4S** | • | 1,7 | 105 | 160 | 26 | 2 | 2 | 25 | 116 | 150 | 2 | 1 |
| **HC7021-E-T-P4S** | • | 1,59 | 105 | 160 | 26 | 2 | 2 | 25 | 116 | 150 | 2 | 1 |
| **M7021-C-T-P4S-XL** | • | 1,6 | 105 | 160 | 26 | 2 | 1 | 17 | 116 | 150 | 2 | 1 |
| **M7021-E-T-P4S-XL** | • | 1,6 | 105 | 160 | 26 | 2 | 1 | 25 | 116 | 150 | 2 | 1 |
| **HCM7021-C-T-P4S-XL** | • | 1,5 | 105 | 160 | 26 | 2 | 1 | 17 | 116 | 150 | 2 | 1 |
| **HCM7021-E-T-P4S-XL** | • | 1,5 | 105 | 160 | 26 | 2 | 1 | 25 | 116 | 150 | 2 | 1 |
| **VCM7021-C-T-P4S-XL** | • | 1,5 | 105 | 160 | 26 | 2 | 1 | 17 | 116 | 150 | 2 | 1 |
| **VCM7021-E-T-P4S-XL** | • | 1,5 | 105 | 160 | 26 | 2 | 1 | 25 | 116 | 150 | 2 | 1 |
| **B7221-C-T-P4S** | | 3,89 | 105 | 190 | 36 | 2,1 | 2,1 | 15 | 120,5 | 174,5 | 2,1 | 1 |
| **B7221-E-T-P4S** | | 3,88 | 105 | 190 | 36 | 2,1 | 2,1 | 25 | 120,5 | 174,5 | 2,1 | 1 |
| **HCB7221-C-T-P4S** | | 3,26 | 105 | 190 | 36 | 2,1 | 2,1 | 15 | 120,5 | 174,5 | 2,1 | 1 |
| **HCB7221-E-T-P4S** | | 3,25 | 105 | 190 | 36 | 2,1 | 2,1 | 25 | 120,5 | 174,5 | 2,1 | 1 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 118,3 | 114,1 | 121,7 | 121,7 | 43000 | 32000 | 13000 | 20000 | 342 | 909 | 1922 | 1016 | 2810 | 6220 | 108 | 160 | 223 |
| 118,3 | 114,1 | 121,7 | 121,7 | 40500 | 31000 | 12000 | 18000 | 489 | 1287 | 2690 | 1414 | 3788 | 8101 | 215 | 306 | 406 |
| 118,3 | 114,1 | 121,7 | 121,7 | 43000 | 31000 | 16000 | 24000 | 240 | 635 | 1336 | 703 | 1915 | 4174 | 106 | 154 | 210 |
| 118,3 | 114,1 | 121,7 | 121,7 | 41000 | 29500 | 16000 | 22000 | 345 | 905 | 1885 | 991 | 2633 | 5578 | 215 | 302 | 397 |
| 118,3 | 114,1 | 121,7 | 121,7 | 103000 | 43000 | 17000 | 24000 | 215 | 569 | 1196 | 629 | 1706 | 3702 | 105 | 152 | 206 |
| 118,3 | 114,1 | 121,7 | 121,7 | 98000 | 41000 | 16000 | 24000 | 310 | 812 | 1691 | 889 | 2358 | 4982 | 213 | 300 | 393 |
| 126,6 | 126,6 | 134,4 | 134,4 | 135000 | 88000 | 7500 | 12000 | 789 | 2466 | 4892 | 2439 | 8230 | 17428 | 121 | 203 | 287 |
| 126,6 | 126,6 | 134,4 | 134,4 | 129000 | 84000 | 6700 | 10000 | 1208 | 3964 | 8152 | 3521 | 11940 | 25355 | 285 | 449 | 604 |
| 126,6 | 126,6 | 134,4 | 134,4 | 135000 | 84000 | 9500 | 16000 | 428 | 1400 | 2856 | 1279 | 4420 | 9498 | 106 | 172 | 240 |
| 126,6 | 126,6 | 134,4 | 134,4 | 129000 | 80000 | 8000 | 13000 | 627 | 2198 | 4619 | 1806 | 6466 | 13894 | 255 | 402 | 535 |
| 117,4 | 117,4 | 121,4 | 121,4 | 60000 | 45000 | 9000 | 14000 | 316 | 1040 | 2101 | 968 | 3432 | 7399 | 94 | 160 | 228 |
| 117,4 | 117,4 | 121,4 | 121,4 | 57000 | 42500 | 8000 | 13000 | 450 | 1616 | 3417 | 1305 | 4839 | 10556 | 219 | 353 | 479 |
| 117,4 | 117,4 | 121,4 | 121,4 | 60000 | 43000 | 13000 | 19000 | 157 | 564 | 1185 | 466 | 1763 | 3895 | 80 | 134 | 188 |
| 117,4 | 117,4 | 121,4 | 121,4 | 57000 | 41000 | 11000 | 17000 | 204 | 850 | 1876 | 584 | 2489 | 5611 | 187 | 311 | 421 |
| 120,2 | 117,3 | 121,9 | 121,9 | 29000 | 24800 | 13000 | 19000 | 101 | 302 | 603 | 299 | 937 | 1946 | 68 | 105 | 143 |
| 120,2 | 117,3 | 121,9 | 121,9 | 27500 | 23400 | 11000 | 17000 | 161 | 483 | 966 | 463 | 1414 | 2880 | 170 | 252 | 327 |
| 120,2 | 117,3 | 121,9 | 121,9 | 27500 | 22400 | 15000 | 22000 | 113 | 338 | 676 | 323 | 980 | 1987 | 170 | 250 | 321 |
| 118,3 | 114,1 | 121,6 | 121,6 | 39000 | 27000 | 13000 | 20000 | 281 | 745 | 1569 | 827 | 2265 | 4962 | 94 | 137 | 188 |
| 118,3 | 114,1 | 121,6 | 121,6 | 37000 | 25500 | 12000 | 18000 | 403 | 1058 | 2207 | 1161 | 3092 | 6571 | 188 | 266 | 351 |
| 118,3 | 114,1 | 121,6 | 121,6 | 39000 | 25500 | 16000 | 24000 | 198 | 521 | 1093 | 575 | 1553 | 3354 | 93 | 134 | 180 |
| 118,3 | 114,1 | 121,6 | 121,6 | 37000 | 24400 | 16000 | 22000 | 285 | 745 | 1549 | 815 | 2157 | 4546 | 189 | 265 | 346 |
| 118,3 | 114,1 | 121,6 | 121,6 | 94000 | 36000 | 17000 | 24000 | 177 | 467 | 979 | 515 | 1385 | 2981 | 92 | 132 | 177 |
| 118,3 | 114,1 | 121,6 | 121,6 | 89000 | 34000 | 16000 | 24000 | 256 | 669 | 1390 | 732 | 1933 | 4065 | 188 | 263 | 343 |
| 123 | 123 | 128,3 | 128,3 | 85000 | 61000 | 8500 | 13000 | 471 | 1511 | 3027 | 1447 | 5010 | 10710 | 107 | 181 | 257 |
| 123 | 123 | 128,3 | 128,3 | 80000 | 58000 | 7500 | 12000 | 691 | 2377 | 4959 | 2010 | 7133 | 15359 | 251 | 399 | 539 |
| 123 | 123 | 128,3 | 128,3 | 85000 | 58000 | 12000 | 18000 | 244 | 836 | 1732 | 725 | 2623 | 5718 | 92 | 153 | 213 |
| 123 | 123 | 128,3 | 128,3 | 81000 | 55000 | 11000 | 16000 | 336 | 1285 | 2768 | 966 | 3768 | 8297 | 219 | 355 | 476 |
| 125,8 | 121,7 | 129 | 129 | 47500 | 36500 | 12000 | 18000 | 164 | 492 | 985 | 489 | 1536 | 3194 | 75 | 117 | 160 |
| 125,8 | 121,7 | 129 | 129 | 45000 | 34500 | 11000 | 16000 | 267 | 802 | 1604 | 770 | 2354 | 4797 | 189 | 281 | 365 |
| 125,8 | 121,7 | 129 | 129 | 45000 | 33000 | 14000 | 22000 | 184 | 552 | 1104 | 527 | 1602 | 3250 | 188 | 277 | 357 |
| 124,9 | 120,1 | 129 | 129 | 53000 | 39500 | 12000 | 19000 | 419 | 1114 | 2356 | 1244 | 3445 | 7626 | 115 | 171 | 238 |
| 124,9 | 120,1 | 129 | 129 | 51000 | 38000 | 12000 | 17000 | 599 | 1574 | 3292 | 1731 | 4636 | 9916 | 229 | 326 | 433 |
| 124,9 | 120,1 | 129 | 129 | 53000 | 38000 | 15000 | 22000 | 294 | 778 | 1638 | 861 | 2347 | 5116 | 113 | 165 | 225 |
| 124,9 | 120,1 | 129 | 129 | 51000 | 36000 | 15000 | 22000 | 422 | 1107 | 2306 | 1213 | 3222 | 6827 | 229 | 323 | 424 |
| 124,9 | 120,1 | 129 | 129 | 128000 | 53000 | 16000 | 24000 | 264 | 697 | 1465 | 770 | 2090 | 4537 | 112 | 163 | 220 |
| 124,9 | 120,1 | 129 | 129 | 122000 | 51000 | 15000 | 22000 | 379 | 994 | 2069 | 1088 | 2885 | 6097 | 228 | 320 | 420 |
| 132,2 | 132,2 | 141,2 | 141,2 | 164000 | 104000 | 7000 | 11000 | 989 | 3069 | 6072 | 3060 | 10252 | 21655 | 131 | 219 | 311 |
| 132,2 | 132,2 | 141,2 | 141,2 | 156000 | 99000 | 6300 | 9500 | 1545 | 5006 | 10249 | 4508 | 15092 | 31918 | 312 | 488 | 656 |
| 132,2 | 132,2 | 141,2 | 141,2 | 164000 | 99000 | 9000 | 15000 | 536 | 1733 | 3524 | 1603 | 5476 | 11721 | 114 | 186 | 258 |
| 132,2 | 132,2 | 141,2 | 141,2 | 157000 | 95000 | 7500 | 12000 | 800 | 2742 | 5723 | 2303 | 8067 | 17220 | 278 | 434 | 577 |

## 2.2.2 Spindle bearings

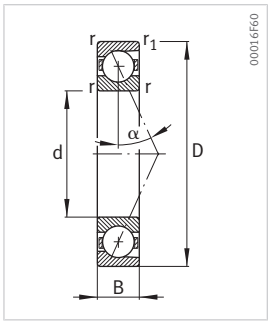
With large, medium or small balls

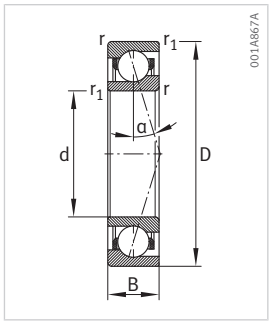
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

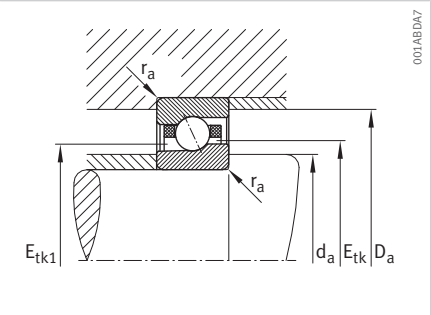
sealed



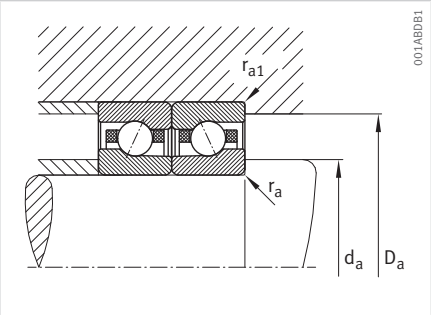




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **B71922-C-T-P4S** | • | 0,85 | 110 | 150 | 20 | 1,1 | 1,1 | 15 | 117 | 143 | 0,6 | 0,6 |
| **B71922-E-T-P4S** | • | 0,85 | 110 | 150 | 20 | 1,1 | 1,1 | 25 | 117 | 143 | 0,6 | 0,6 |
| **HCB71922-C-T-P4S** | • | 0,71 | 110 | 150 | 20 | 1,1 | 1,1 | 15 | 117 | 143 | 0,6 | 0,6 |
| **HCB71922-E-T-P4S** | • | 0,71 | 110 | 150 | 20 | 1,1 | 1,1 | 25 | 117 | 143 | 0,6 | 0,6 |
| **HS71922-C-T-P4S** | • | 0,91 | 110 | 150 | 20 | 1,1 | 1,1 | 15 | 117 | 143 | 0,6 | 0,6 |
| **HS71922-E-T-P4S** | • | 0,91 | 110 | 150 | 20 | 1,1 | 1,1 | 25 | 117 | 143 | 0,6 | 0,6 |
| **HC71922-E-T-P4S** | • | 0,84 | 110 | 150 | 20 | 1,1 | 1,1 | 25 | 117 | 143 | 0,6 | 0,6 |
| **M71922-C-T-P4S-XL** | • | 0,82 | 110 | 150 | 20 | 1,1 | 0,6 | 17 | 117 | 143 | 0,6 | 0,6 |
| **M71922-E-T-P4S-XL** | • | 0,82 | 110 | 150 | 20 | 1,1 | 0,6 | 25 | 117 | 143 | 0,6 | 0,6 |
| **HCM71922-C-T-P4S-XL** | • | 0,72 | 110 | 150 | 20 | 1,1 | 0,6 | 17 | 117 | 143 | 0,6 | 0,6 |
| **HCM71922-E-T-P4S-XL** | • | 0,72 | 110 | 150 | 20 | 1,1 | 0,6 | 25 | 117 | 143 | 0,6 | 0,6 |
| **VCM71922-C-T-P4S-XL** | • | 0,72 | 110 | 150 | 20 | 1,1 | 0,6 | 17 | 117 | 143 | 0,6 | 0,6 |
| **VCM71922-E-T-P4S-XL** | • | 0,72 | 110 | 150 | 20 | 1,1 | 0,6 | 25 | 117 | 143 | 0,6 | 0,6 |
| **B7022-C-T-P4S** | • | 1,95 | 110 | 170 | 28 | 2 | 2 | 15 | 121 | 159 | 2 | 1 |
| **B7022-E-T-P4S** | • | 1,95 | 110 | 170 | 28 | 2 | 2 | 25 | 121 | 159 | 2 | 1 |
| **HCB7022-C-T-P4S** | • | 1,62 | 110 | 170 | 28 | 2 | 2 | 15 | 121 | 159 | 2 | 1 |
| **HCB7022-E-T-P4S** | • | 1,62 | 110 | 170 | 28 | 2 | 2 | 25 | 121 | 159 | 2 | 1 |
| **HS7022-C-T-P4S** | • | 2,17 | 110 | 170 | 28 | 2 | 2 | 15 | 121 | 159 | 2 | 1 |
| **HS7022-E-T-P4S** | • | 2,17 | 110 | 170 | 28 | 2 | 2 | 25 | 121 | 159 | 2 | 1 |
| **HC7022-E-T-P4S** | • | 2,05 | 110 | 170 | 28 | 2 | 2 | 25 | 121 | 159 | 2 | 1 |
| **M7022-C-T-P4S-XL** | • | 2,1 | 110 | 170 | 28 | 2 | 1 | 17 | 121 | 159 | 2 | 1 |
| **M7022-E-T-P4S-XL** | • | 2,1 | 110 | 170 | 28 | 2 | 1 | 25 | 121 | 159 | 2 | 1 |
| **HCM7022-C-T-P4S-XL** | • | 1,9 | 110 | 170 | 28 | 2 | 1 | 17 | 121 | 159 | 2 | 1 |
| **HCM7022-E-T-P4S-XL** | • | 1,9 | 110 | 170 | 28 | 2 | 1 | 25 | 121 | 159 | 2 | 1 |
| **VCM7022-C-T-P4S-XL** | • | 2,09 | 110 | 170 | 28 | 2 | 1 | 17 | 121 | 159 | 2 | 1 |
| **VCM7022-E-T-P4S-XL** | • | 2,09 | 110 | 170 | 28 | 2 | 1 | 25 | 121 | 159 | 2 | 1 |
| **B7222-C-T-P4S** | | 4,6 | 110 | 200 | 38 | 2,1 | 2,1 | 15 | 126,5 | 183,5 | 2,1 | 1 |
| **B7222-E-T-P4S** | | 4,59 | 110 | 200 | 38 | 2,1 | 2,1 | 25 | 126,5 | 183,5 | 2,1 | 1 |
| **HCB7222-C-T-P4S** | | 3,97 | 110 | 200 | 38 | 2,1 | 2,1 | 15 | 126,5 | 183,5 | 2,1 | 1 |
| **HCB7222-E-T-P4S** | | 3,96 | 110 | 200 | 38 | 2,1 | 2,1 | 25 | 126,5 | 183,5 | 2,1 | 1 |
| **B71924-C-T-P4S** | • | 1,16 | 120 | 165 | 22 | 1,1 | 1,1 | 15 | 128 | 157 | 0,6 | 0,6 |
| **B71924-E-T-P4S** | • | 1,16 | 120 | 165 | 22 | 1,1 | 1,1 | 25 | 128 | 157 | 0,6 | 0,6 |
| **HCB71924-C-T-P4S** | • | 0,97 | 120 | 165 | 22 | 1,1 | 1,1 | 15 | 128 | 157 | 0,6 | 0,6 |
| **HCB71924-E-T-P4S** | • | 0,97 | 120 | 165 | 22 | 1,1 | 1,1 | 25 | 128 | 157 | 0,6 | 0,6 |
| **HS71924-C-T-P4S** | • | 1,29 | 120 | 165 | 22 | 1,1 | 1,1 | 15 | 128 | 157 | 0,6 | 0,6 |
| **HS71924-E-T-P4S** | • | 1,29 | 120 | 165 | 22 | 1,1 | 1,1 | 25 | 128 | 157 | 0,6 | 0,6 |
| **HC71924-E-T-P4S** | • | 1,21 | 120 | 165 | 22 | 1,1 | 1,1 | 25 | 128 | 157 | 0,6 | 0,6 |
| **M71924-C-T-P4S-XL** | • | 1,1 | 120 | 165 | 22 | 1,1 | 0,6 | 17 | 128 | 157 | 0,6 | 0,6 |
| **M71924-E-T-P4S-XL** | • | 1,1 | 120 | 165 | 22 | 1,1 | 0,6 | 25 | 128 | 157 | 0,6 | 0,6 |
| **HCM71924-C-T-P4S-XL** | • | 0,97 | 120 | 165 | 22 | 1,1 | 0,6 | 17 | 128 | 157 | 0,6 | 0,6 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 122,4 | 122,4 | 126,4 | 126,4 | 61000 | 47000 | 8500 | 13000 | 314 | 1038 | 2102 | 961 | 3415 | 7373 | 96 | 163 | 232 |
| 122,4 | 122,4 | 126,4 | 126,4 | 58000 | 44500 | 8000 | 12000 | 455 | 1642 | 3475 | 1321 | 4913 | 10722 | 225 | 364 | 493 |
| 122,4 | 122,4 | 126,4 | 126,4 | 61000 | 45000 | 12000 | 19000 | 158 | 570 | 1199 | 468 | 1777 | 3931 | 82 | 138 | 193 |
| 122,4 | 122,4 | 126,4 | 126,4 | 58000 | 42500 | 11000 | 17000 | 208 | 871 | 1923 | 596 | 2547 | 5747 | 193 | 322 | 435 |
| 124,8 | 121,5 | 126,9 | 126,9 | 34000 | 28500 | 12000 | 19000 | 116 | 347 | 693 | 344 | 1077 | 2238 | 71 | 110 | 149 |
| 124,8 | 121,5 | 126,9 | 126,9 | 32000 | 27000 | 11000 | 17000 | 187 | 561 | 1121 | 538 | 1642 | 3344 | 178 | 264 | 343 |
| 124,8 | 121,5 | 126,9 | 126,9 | 32000 | 26000 | 14000 | 22000 | 131 | 393 | 787 | 375 | 1141 | 2312 | 178 | 262 | 337 |
| 123,3 | 119,1 | 126,5 | 126,5 | 39500 | 28000 | 13000 | 19000 | 292 | 775 | 1633 | 861 | 2357 | 5165 | 97 | 142 | 195 |
| 123,3 | 119,1 | 126,5 | 126,5 | 37500 | 26500 | 12000 | 18000 | 419 | 1101 | 2296 | 1208 | 3217 | 6837 | 195 | 276 | 365 |
| 123,3 | 119,1 | 126,5 | 126,5 | 39500 | 26500 | 16000 | 22000 | 206 | 542 | 1138 | 598 | 1616 | 3491 | 96 | 139 | 187 |
| 123,3 | 119,1 | 126,5 | 126,5 | 38000 | 25500 | 15000 | 22000 | 296 | 775 | 1612 | 848 | 2244 | 4730 | 196 | 275 | 359 |
| 123,3 | 119,1 | 126,5 | 126,5 | 95000 | 37500 | 16000 | 22000 | 185 | 486 | 1019 | 536 | 1442 | 3103 | 96 | 137 | 184 |
| 123,3 | 119,1 | 126,5 | 126,5 | 91000 | 35500 | 15000 | 22000 | 266 | 696 | 1446 | 761 | 2010 | 4230 | 195 | 273 | 356 |
| 128,6 | 128,6 | 135,1 | 135,1 | 112000 | 77000 | 8000 | 12000 | 643 | 2033 | 4052 | 1981 | 6757 | 14370 | 119 | 200 | 283 |
| 128,6 | 128,6 | 135,1 | 135,1 | 106000 | 73000 | 7500 | 12000 | 968 | 3242 | 6709 | 2820 | 9745 | 20814 | 280 | 443 | 596 |
| 128,6 | 128,6 | 135,1 | 135,1 | 112000 | 74000 | 12000 | 18000 | 337 | 1126 | 2314 | 1004 | 3540 | 7655 | 103 | 169 | 234 |
| 128,6 | 128,6 | 135,1 | 135,1 | 106000 | 70000 | 11000 | 16000 | 490 | 1779 | 3778 | 1409 | 5224 | 11341 | 248 | 395 | 527 |
| 133,3 | 129,2 | 136,5 | 136,5 | 48000 | 38000 | 12000 | 18000 | 168 | 503 | 1005 | 499 | 1566 | 3257 | 77 | 121 | 164 |
| 133,3 | 129,2 | 136,5 | 136,5 | 45500 | 35500 | 11000 | 16000 | 267 | 802 | 1604 | 770 | 2352 | 4792 | 193 | 287 | 373 |
| 133,3 | 129,2 | 136,5 | 136,5 | 45500 | 34000 | 13000 | 20000 | 187 | 561 | 1121 | 535 | 1627 | 3299 | 193 | 284 | 366 |
| 132,4 | 127,6 | 136,4 | 136,4 | 54000 | 41500 | 12000 | 18000 | 437 | 1164 | 2461 | 1300 | 3600 | 7970 | 120 | 178 | 248 |
| 132,4 | 127,6 | 136,4 | 136,4 | 51000 | 39500 | 11000 | 16000 | 625 | 1644 | 3437 | 1807 | 4841 | 10356 | 238 | 339 | 451 |
| 132,4 | 127,6 | 136,4 | 136,4 | 54000 | 39500 | 15000 | 22000 | 307 | 813 | 1711 | 900 | 2452 | 5346 | 118 | 171 | 234 |
| 132,4 | 127,6 | 136,4 | 136,4 | 51000 | 37500 | 14000 | 20000 | 441 | 1156 | 2408 | 1266 | 3365 | 7129 | 238 | 335 | 441 |
| 132,4 | 127,6 | 136,4 | 136,4 | 129000 | 55000 | 15000 | 22000 | 276 | 728 | 1530 | 805 | 2184 | 4742 | 117 | 169 | 229 |
| 132,4 | 127,6 | 136,4 | 136,4 | 123000 | 53000 | 14000 | 22000 | 396 | 1038 | 2160 | 1136 | 3012 | 6367 | 237 | 333 | 436 |
| 139,7 | 139,7 | 148,7 | 148,7 | 164000 | 105000 | 6700 | 10000 | 989 | 3069 | 6072 | 3060 | 10252 | 21655 | 131 | 219 | 311 |
| 139,7 | 139,7 | 148,7 | 148,7 | 156000 | 100000 | 6000 | 9000 | 1512 | 4905 | 10048 | 4410 | 14777 | 31257 | 309 | 484 | 650 |
| 139,7 | 139,7 | 148,7 | 148,7 | 164000 | 101000 | 8500 | 14000 | 536 | 1733 | 3524 | 1603 | 5476 | 11721 | 114 | 186 | 258 |
| 139,7 | 139,7 | 148,7 | 148,7 | 156000 | 96000 | 7000 | 10000 | 800 | 2742 | 5723 | 2303 | 8067 | 17220 | 278 | 434 | 577 |
| 134 | 134 | 138,5 | 138,5 | 76000 | 59000 | 8000 | 12000 | 405 | 1321 | 2665 | 1239 | 4349 | 9350 | 109 | 184 | 261 |
| 134 | 134 | 138,5 | 138,5 | 72000 | 56000 | 7000 | 11000 | 587 | 2073 | 4361 | 1705 | 6203 | 13450 | 255 | 409 | 553 |
| 134 | 134 | 138,5 | 138,5 | 76000 | 57000 | 11000 | 17000 | 208 | 732 | 1530 | 616 | 2286 | 5019 | 94 | 156 | 218 |
| 134 | 134 | 138,5 | 138,5 | 72000 | 54000 | 10000 | 15000 | 274 | 1101 | 2407 | 785 | 3223 | 7191 | 220 | 362 | 487 |
| 137,3 | 134 | 139,2 | 139,2 | 35500 | 32000 | 11000 | 17000 | 122 | 367 | 734 | 363 | 1137 | 2362 | 77 | 119 | 162 |
| 137,3 | 134 | 139,2 | 139,2 | 33500 | 30000 | 10000 | 15000 | 196 | 587 | 1173 | 562 | 1716 | 3492 | 193 | 286 | 371 |
| 137,3 | 134 | 139,2 | 139,2 | 33500 | 29000 | 13000 | 20000 | 136 | 407 | 814 | 388 | 1179 | 2389 | 192 | 283 | 364 |
| 134,9 | 130,1 | 138,8 | 138,8 | 49500 | 35000 | 12000 | 18000 | 366 | 970 | 2045 | 1077 | 2950 | 6464 | 107 | 157 | 215 |
| 134,9 | 130,1 | 138,8 | 138,8 | 47000 | 33000 | 11000 | 16000 | 525 | 1379 | 2875 | 1512 | 4028 | 8558 | 215 | 304 | 401 |
| 134,9 | 130,1 | 138,8 | 138,8 | 49500 | 33500 | 14000 | 22000 | 257 | 679 | 1425 | 749 | 2023 | 4370 | 106 | 152 | 205 |

## 2.2.2 Spindle bearings

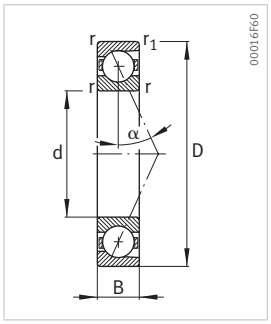
With large, medium or small balls

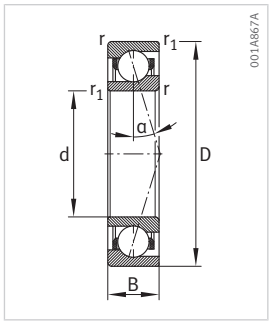
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

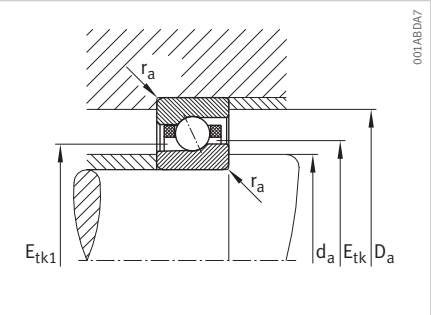
sealed



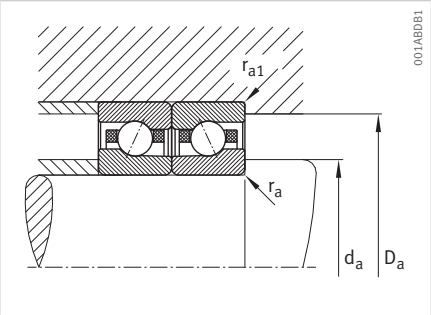




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCM71924-E-T-P4S-XL** | • | 0,97 | 120 | 165 | 22 | 1,1 | 0,6 | 25 | 128 | 157 | 0,6 | 0,6 |
| **VCM71924-C-T-P4S-XL** | • | 1,11 | 120 | 165 | 22 | 1,1 | 0,6 | 17 | 128 | 157 | 0,6 | 0,6 |
| **VCM71924-E-T-P4S-XL** | • | 1,11 | 120 | 165 | 22 | 1,1 | 0,6 | 25 | 128 | 157 | 0,6 | 0,6 |
| **B7024-C-T-P4S** | • | 2,08 | 120 | 180 | 28 | 2 | 2 | 15 | 131 | 169 | 2 | 1 |
| **B7024-E-T-P4S** | • | 2,07 | 120 | 180 | 28 | 2 | 2 | 25 | 131 | 169 | 2 | 1 |
| **HCB7024-C-T-P4S** | • | 1,74 | 120 | 180 | 28 | 2 | 2 | 15 | 131 | 169 | 2 | 1 |
| **HCB7024-E-T-P4S** | • | 1,73 | 120 | 180 | 28 | 2 | 2 | 25 | 131 | 169 | 2 | 1 |
| **HS7024-C-T-P4S** | • | 2,33 | 120 | 180 | 28 | 2 | 2 | 15 | 131 | 169 | 2 | 1 |
| **HS7024-E-T-P4S** | • | 2,32 | 120 | 180 | 28 | 2 | 2 | 25 | 131 | 169 | 2 | 1 |
| **HC7024-E-T-P4S** | • | 2,2 | 120 | 180 | 28 | 2 | 2 | 25 | 131 | 169 | 2 | 1 |
| **M7024-C-T-P4S-XL** | • | 2,2 | 120 | 180 | 28 | 2 | 1 | 17 | 131 | 169 | 2 | 1 |
| **M7024-E-T-P4S-XL** | • | 2,2 | 120 | 180 | 28 | 2 | 1 | 25 | 131 | 169 | 2 | 1 |
| **HCM7024-C-T-P4S-XL** | • | 2,1 | 120 | 180 | 28 | 2 | 1 | 17 | 131 | 169 | 2 | 1 |
| **HCM7024-E-T-P4S-XL** | • | 2,1 | 120 | 180 | 28 | 2 | 1 | 25 | 131 | 169 | 2 | 1 |
| **VCM7024-C-T-P4S-XL** | • | 2,23 | 120 | 180 | 28 | 2 | 1 | 17 | 131 | 169 | 2 | 1 |
| **VCM7024-E-T-P4S-XL** | • | 2,23 | 120 | 180 | 28 | 2 | 1 | 25 | 131 | 169 | 2 | 1 |
| **B7224-C-T-P4S** | | 5,3 | 120 | 215 | 40 | 2,1 | 2,1 | 15 | 140 | 195 | 2,1 | 1 |
| **B7224-E-T-P4S** | | 5,28 | 120 | 215 | 40 | 2,1 | 2,1 | 25 | 140 | 195 | 2,1 | 1 |
| **HCB7224-C-T-P4S** | | 4,2 | 120 | 215 | 40 | 2,1 | 2,1 | 15 | 140 | 195 | 2,1 | 1 |
| **HCB7224-E-T-P4S** | | 4,18 | 120 | 215 | 40 | 2,1 | 2,1 | 25 | 140 | 195 | 2,1 | 1 |
| **B71926-C-T-P4S** | • | 1,52 | 130 | 180 | 24 | 1,5 | 1,5 | 15 | 139 | 171 | 0,6 | 0,6 |
| **B71926-E-T-P4S** | • | 1,52 | 130 | 180 | 24 | 1,5 | 1,5 | 25 | 139 | 171 | 0,6 | 0,6 |
| **HCB71926-C-T-P4S** | • | 1,34 | 130 | 180 | 24 | 1,5 | 1,5 | 15 | 139 | 171 | 0,6 | 0,6 |
| **HCB71926-E-T-P4S** | • | 1,34 | 130 | 180 | 24 | 1,5 | 1,5 | 25 | 139 | 171 | 0,6 | 0,6 |
| **HS71926-C-T-P4S** | • | 1,71 | 130 | 180 | 24 | 1,5 | 1,5 | 15 | 139 | 171 | 0,6 | 0,6 |
| **HS71926-E-T-P4S** | • | 1,71 | 130 | 180 | 24 | 1,5 | 1,5 | 25 | 139 | 171 | 0,6 | 0,6 |
| **HC71926-E-T-P4S** | • | 1,61 | 130 | 180 | 24 | 1,5 | 1,5 | 25 | 139 | 171 | 0,6 | 0,6 |
| **M71926-C-T-P4S-XL** | • | 1,5 | 130 | 180 | 24 | 1,5 | 1 | 17 | 139 | 171 | 0,6 | 0,6 |
| **M71926-E-T-P4S-XL** | • | 1,5 | 130 | 180 | 24 | 1,5 | 1 | 25 | 139 | 171 | 0,6 | 0,6 |
| **HCM71926-C-T-P4S-XL** | • | 1,4 | 130 | 180 | 24 | 1,5 | 1 | 17 | 139 | 171 | 0,6 | 0,6 |
| **HCM71926-E-T-P4S-XL** | • | 1,4 | 130 | 180 | 24 | 1,5 | 1 | 25 | 139 | 171 | 0,6 | 0,6 |
| **VCM71926-C-T-P4S-XL** | • | 1,53 | 130 | 180 | 24 | 1,5 | 1 | 17 | 139 | 171 | 0,6 | 0,6 |
| **VCM71926-E-T-P4S-XL** | • | 1,53 | 130 | 180 | 24 | 1,5 | 1 | 25 | 139 | 171 | 0,6 | 0,6 |
| **B7026-C-T-P4S** | • | 3,16 | 130 | 200 | 33 | 2 | 2 | 15 | 142 | 189 | 2 | 1 |
| **B7026-E-T-P4S** | • | 3,15 | 130 | 200 | 33 | 2 | 2 | 25 | 142 | 189 | 2 | 1 |
| **HCB7026-C-T-P4S** | • | 2,63 | 130 | 200 | 33 | 2 | 2 | 15 | 142 | 189 | 2 | 1 |
| **HCB7026-E-T-P4S** | • | 2,61 | 130 | 200 | 33 | 2 | 2 | 25 | 142 | 189 | 2 | 1 |
| **HS7026-C-T-P4S** | • | 3,52 | 130 | 200 | 33 | 2 | 2 | 15 | 142 | 189 | 2 | 1 |
| **HS7026-E-T-P4S** | • | 3,51 | 130 | 200 | 33 | 2 | 2 | 25 | 142 | 189 | 2 | 1 |
| **HC7026-E-T-P4S** | • | 3,36 | 130 | 200 | 33 | 2 | 2 | 25 | 142 | 189 | 2 | 1 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 134,9 | 130,1 | 138,8 | 138,8 | 47000 | 32000 | 14000 | 20000 | 371 | 971 | 2018 | 1062 | 2809 | 5922 | 215 | 302 | 395 |
| 134,9 | 130,1 | 138,8 | 138,8 | 119000 | 46500 | 15000 | 22000 | 231 | 609 | 1276 | 671 | 1805 | 3884 | 105 | 151 | 202 |
| 134,9 | 130,1 | 138,8 | 138,8 | 113000 | 44500 | 14000 | 22000 | 333 | 872 | 1811 | 953 | 2517 | 5296 | 214 | 300 | 391 |
| 138,6 | 138,6 | 145,1 | 145,1 | 115000 | 82000 | 7500 | 12000 | 653 | 2069 | 4129 | 2008 | 6858 | 14599 | 123 | 206 | 293 |
| 138,6 | 138,6 | 145,1 | 145,1 | 109000 | 78000 | 6700 | 10000 | 983 | 3298 | 6830 | 2860 | 9902 | 21158 | 290 | 459 | 618 |
| 138,6 | 138,6 | 145,1 | 145,1 | 115000 | 78000 | 10000 | 16000 | 350 | 1170 | 2406 | 1042 | 3677 | 7953 | 107 | 176 | 245 |
| 138,6 | 138,6 | 145,1 | 145,1 | 109000 | 75000 | 9500 | 14000 | 496 | 1810 | 3849 | 1427 | 5313 | 11543 | 257 | 410 | 547 |
| 143,3 | 139,2 | 146,4 | 146,4 | 49500 | 40500 | 10000 | 16000 | 171 | 513 | 1025 | 508 | 1594 | 3313 | 81 | 126 | 171 |
| 143,3 | 139,2 | 146,4 | 146,4 | 46500 | 38500 | 9500 | 14000 | 276 | 828 | 1656 | 795 | 2426 | 4942 | 203 | 302 | 392 |
| 143,3 | 139,2 | 146,4 | 146,4 | 46500 | 36500 | 12000 | 19000 | 193 | 578 | 1156 | 552 | 1676 | 3398 | 203 | 299 | 385 |
| 142,4 | 137,6 | 146,4 | 146,4 | 56000 | 44500 | 11000 | 17000 | 473 | 1258 | 2659 | 1405 | 3891 | 8618 | 129 | 191 | 266 |
| 142,4 | 137,6 | 146,4 | 146,4 | 53000 | 42500 | 10000 | 15000 | 675 | 1775 | 3712 | 1952 | 5229 | 11187 | 256 | 364 | 484 |
| 142,4 | 137,6 | 146,4 | 146,4 | 56000 | 42500 | 14000 | 19000 | 332 | 878 | 1848 | 972 | 2650 | 5780 | 127 | 184 | 251 |
| 142,4 | 137,6 | 146,4 | 146,4 | 53000 | 40500 | 13000 | 19000 | 476 | 1248 | 2601 | 1368 | 3634 | 7700 | 255 | 360 | 474 |
| 142,4 | 137,6 | 146,4 | 146,4 | 134000 | 60000 | 14000 | 19000 | 298 | 787 | 1654 | 870 | 2361 | 5126 | 126 | 182 | 246 |
| 142,4 | 137,6 | 146,4 | 146,4 | 127000 | 57000 | 13000 | 19000 | 428 | 1120 | 2332 | 1227 | 3253 | 6877 | 254 | 358 | 469 |
| 148,4 | 148,4 | 159,7 | 159,7 | 205000 | 138000 | 6000 | 9000 | 1259 | 3882 | 7683 | 3878 | 12884 | 27179 | 139 | 231 | 326 |
| 148,4 | 148,4 | 159,7 | 159,7 | 196000 | 132000 | 5300 | 8000 | 1989 | 6365 | 12984 | 5797 | 19139 | 40275 | 333 | 518 | 694 |
| 148,4 | 148,4 | 159,7 | 159,7 | 205000 | 132000 | 7500 | 12000 | 688 | 2196 | 4452 | 2051 | 6906 | 14713 | 122 | 197 | 272 |
| 148,4 | 148,4 | 159,7 | 159,7 | 196000 | 126000 | 6700 | 9500 | 1055 | 3535 | 7327 | 3037 | 10386 | 21994 | 300 | 465 | 615 |
| 145,5 | 145,5 | 150,7 | 150,7 | 90000 | 71000 | 7000 | 11000 | 486 | 1571 | 3160 | 1488 | 5171 | 11084 | 117 | 197 | 279 |
| 145,5 | 145,5 | 150,7 | 150,7 | 85000 | 67000 | 6700 | 10000 | 711 | 2466 | 5161 | 2064 | 7379 | 15916 | 275 | 438 | 590 |
| 145,5 | 145,5 | 150,7 | 150,7 | 90000 | 68000 | 10000 | 15000 | 253 | 875 | 1819 | 750 | 2732 | 5967 | 101 | 167 | 233 |
| 145,5 | 145,5 | 150,7 | 150,7 | 86000 | 64000 | 9000 | 14000 | 346 | 1342 | 2904 | 993 | 3929 | 8680 | 240 | 391 | 524 |
| 149,3 | 145,8 | 151,4 | 151,4 | 40500 | 36500 | 10000 | 16000 | 139 | 417 | 834 | 413 | 1291 | 2682 | 81 | 126 | 171 |
| 149,3 | 145,8 | 151,4 | 151,4 | 38500 | 34500 | 9000 | 14000 | 224 | 673 | 1346 | 645 | 1968 | 4004 | 205 | 303 | 393 |
| 149,3 | 145,8 | 151,4 | 151,4 | 38500 | 33000 | 12000 | 18000 | 155 | 466 | 932 | 444 | 1349 | 2732 | 204 | 300 | 385 |
| 147,4 | 142,6 | 151,3 | 151,3 | 51000 | 37500 | 11000 | 16000 | 396 | 1050 | 2213 | 1166 | 3194 | 7000 | 115 | 169 | 231 |
| 147,4 | 142,6 | 151,3 | 151,3 | 48500 | 36000 | 10000 | 15000 | 568 | 1491 | 3109 | 1635 | 4356 | 9258 | 231 | 327 | 431 |
| 147,4 | 142,6 | 151,3 | 151,3 | 51000 | 36000 | 13000 | 19000 | 279 | 735 | 1542 | 811 | 2190 | 4731 | 114 | 164 | 221 |
| 147,4 | 142,6 | 151,3 | 151,3 | 48500 | 34500 | 13000 | 18000 | 401 | 1050 | 2183 | 1148 | 3038 | 6405 | 231 | 325 | 424 |
| 147,4 | 142,6 | 151,3 | 151,3 | 122000 | 50000 | 14000 | 19000 | 250 | 659 | 1380 | 726 | 1954 | 4205 | 113 | 162 | 217 |
| 147,4 | 142,6 | 151,3 | 151,3 | 117000 | 48000 | 13000 | 19000 | 360 | 943 | 1959 | 1031 | 2723 | 5728 | 230 | 323 | 421 |
| 151,6 | 151,6 | 159,3 | 159,3 | 149000 | 107000 | 6700 | 10000 | 850 | 2669 | 5314 | 2616 | 8846 | 18773 | 137 | 229 | 324 |
| 151,6 | 151,6 | 159,3 | 159,3 | 141000 | 102000 | 6000 | 9500 | 1312 | 4328 | 8915 | 3820 | 13001 | 27627 | 326 | 512 | 689 |
| 151,6 | 151,6 | 159,3 | 159,3 | 149000 | 102000 | 9500 | 14000 | 464 | 1524 | 3119 | 1381 | 4791 | 10306 | 120 | 196 | 272 |
| 151,6 | 151,6 | 159,3 | 159,3 | 141000 | 97000 | 8500 | 13000 | 679 | 2399 | 5054 | 1953 | 7044 | 15161 | 291 | 459 | 611 |
| 157,4 | 152,6 | 161,2 | 161,2 | 64000 | 53000 | 9500 | 15000 | 219 | 658 | 1317 | 653 | 2046 | 4251 | 92 | 143 | 194 |
| 157,4 | 152,6 | 161,2 | 161,2 | 60000 | 50000 | 8500 | 13000 | 357 | 1070 | 2139 | 1026 | 3133 | 6381 | 231 | 344 | 446 |
| 157,4 | 152,6 | 161,2 | 161,2 | 60000 | 48000 | 11000 | 17000 | 244 | 733 | 1466 | 700 | 2126 | 4308 | 230 | 338 | 435 |

## 2.2.2 Spindle bearings

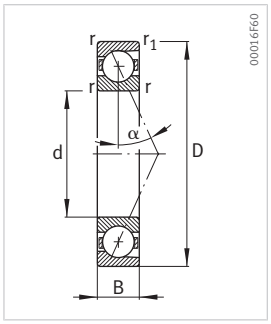
With large, medium or small balls

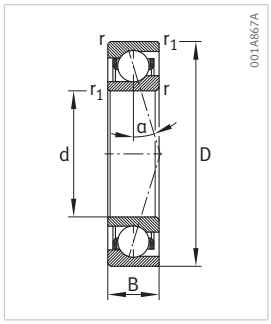
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

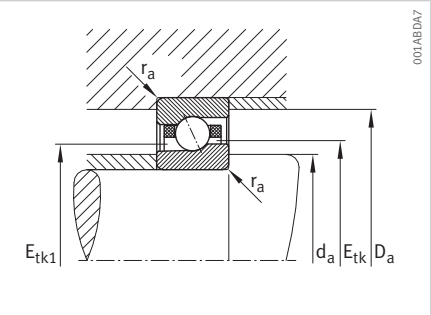
sealed



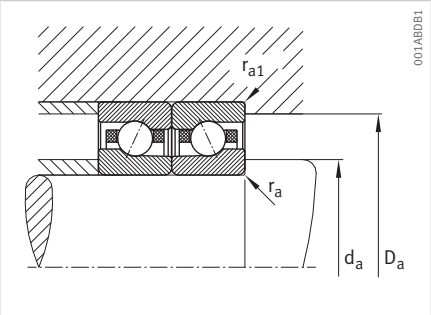




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **M7026-C-T-P4S-XL** | • | 3,6 | 130 | 200 | 33 | 2 | 1 | 17 | 142 | 189 | 2 | 1 |
| **M7026-E-T-P4S-XL** | • | 3,6 | 130 | 200 | 33 | 2 | 1 | 25 | 142 | 189 | 2 | 1 |
| **HCM7026-C-T-P4S-XL** | • | 3,4 | 130 | 200 | 33 | 2 | 1 | 17 | 142 | 189 | 2 | 1 |
| **HCM7026-E-T-P4S-XL** | • | 3,4 | 130 | 200 | 33 | 2 | 1 | 25 | 142 | 189 | 2 | 1 |
| **VCM7026-C-T-P4S-XL** | • | 3,56 | 130 | 200 | 33 | 2 | 1 | 17 | 142 | 189 | 2 | 1 |
| **VCM7026-E-T-P4S-XL** | • | 3,56 | 130 | 200 | 33 | 2 | 1 | 25 | 142 | 189 | 2 | 1 |
| **B7226-C-T-P4S** | | 6,11 | 130 | 230 | 40 | 3 | 3 | 15 | 148 | 211,5 | 2,5 | 1 |
| **B7226-E-T-P4S** | | 6,09 | 130 | 230 | 40 | 3 | 3 | 25 | 148 | 211,5 | 2,5 | 1 |
| **HCB7226-C-T-P4S** | | 4,94 | 130 | 230 | 40 | 3 | 3 | 15 | 148 | 211,5 | 2,5 | 1 |
| **HCB7226-E-T-P4S** | | 4,92 | 130 | 230 | 40 | 3 | 3 | 25 | 148 | 211,5 | 2,5 | 1 |
| **B71928-C-T-P4S** | • | 1,62 | 140 | 190 | 24 | 1,5 | 1,5 | 15 | 149 | 181 | 0,6 | 0,6 |
| **B71928-E-T-P4S** | • | 1,62 | 140 | 190 | 24 | 1,5 | 1,5 | 25 | 149 | 181 | 0,6 | 0,6 |
| **HCB71928-C-T-P4S** | • | 1,42 | 140 | 190 | 24 | 1,5 | 1,5 | 15 | 149 | 181 | 0,6 | 0,6 |
| **HCB71928-E-T-P4S** | • | 1,42 | 140 | 190 | 24 | 1,5 | 1,5 | 25 | 149 | 181 | 0,6 | 0,6 |
| **B7028-C-T-P4S** | • | 3,35 | 140 | 210 | 33 | 2 | 2 | 15 | 152 | 199 | 2 | 1 |
| **B7028-E-T-P4S** | • | 3,34 | 140 | 210 | 33 | 2 | 2 | 25 | 152 | 199 | 2 | 1 |
| **HCB7028-C-T-P4S** | • | 2,79 | 140 | 210 | 33 | 2 | 2 | 15 | 152 | 199 | 2 | 1 |
| **HCB7028-E-T-P4S** | • | 2,78 | 140 | 210 | 33 | 2 | 2 | 25 | 152 | 199 | 2 | 1 |
| **B7228-C-T-P4S** | | 7,88 | 140 | 250 | 42 | 3 | 3 | 15 | 163 | 226,5 | 2,5 | 2,5 |
| **B7228-E-T-P4S** | | 7,86 | 140 | 250 | 42 | 3 | 3 | 25 | 163 | 226,5 | 2,5 | 2,5 |
| **HCB7228-C-T-P4S** | | 6,62 | 140 | 250 | 42 | 3 | 3 | 15 | 163 | 226,5 | 2,5 | 2,5 |
| **HCB7228-E-T-P4S** | | 6,6 | 140 | 250 | 42 | 3 | 3 | 25 | 163 | 226,5 | 2,5 | 2,5 |
| **B71930-E-T-P4S** | | 2,49 | 150 | 210 | 28 | 2 | 1 | 25 | 160 | 199 | 1 | 1 |
| **B71930-C-T-P4S** | | 2,49 | 150 | 210 | 28 | 2 | 1 | 15 | 160 | 199 | 1 | 1 |
| **HCB71930-C-T-P4S** | | 2,09 | 150 | 210 | 28 | 2 | 1 | 15 | 160 | 199 | 1 | 1 |
| **HCB71930-E-T-P4S** | | 2,09 | 150 | 210 | 28 | 2 | 1 | 25 | 160 | 199 | 1 | 1 |
| **B7030-C-T-P4S** | | 4,04 | 150 | 225 | 35 | 2,1 | 2,1 | 15 | 163 | 213 | 2,1 | 1 |
| **B7030-E-T-P4S** | | 4,03 | 150 | 225 | 35 | 2,1 | 2,1 | 25 | 163 | 213 | 2,1 | 1 |
| **HCB7030-C-T-P4S** | | 3,25 | 150 | 225 | 35 | 2,1 | 2,1 | 15 | 163 | 213 | 2,1 | 1 |
| **HCB7030-E-T-P4S** | | 3,24 | 150 | 225 | 35 | 2,1 | 2,1 | 25 | 163 | 213 | 2,1 | 1 |
| **B7230-C-T-P4S** | | 10,1 | 150 | 270 | 45 | 3 | 3 | 15 | 178 | 241,5 | 2,5 | 2,5 |
| **B7230-E-T-P4S** | | 10,1 | 150 | 270 | 45 | 3 | 3 | 25 | 178 | 241,5 | 2,5 | 2,5 |
| **HCB7230-C-T-P4S** | | 8,82 | 150 | 270 | 45 | 3 | 3 | 15 | 178 | 241,5 | 2,5 | 2,5 |
| **HCB7230-E-T-P4S** | | 8,79 | 150 | 270 | 45 | 3 | 3 | 25 | 178 | 241,5 | 2,5 | 2,5 |
| **B71932-C-T-P4S** | | 2,63 | 160 | 220 | 28 | 2 | 1 | 15 | 170 | 209 | 1 | 1 |
| **B71932-E-T-P4S** | | 2,62 | 160 | 220 | 28 | 2 | 1 | 25 | 170 | 209 | 1 | 1 |
| **HCB71932-C-T-P4S** | | 2,21 | 160 | 220 | 28 | 2 | 1 | 15 | 170 | 209 | 1 | 1 |
| **HCB71932-E-T-P4S** | | 2,2 | 160 | 220 | 28 | 2 | 1 | 25 | 170 | 209 | 1 | 1 |
| **B7032-C-T-P4S** | | 5,04 | 160 | 240 | 38 | 2,1 | 2,1 | 15 | 174 | 228 | 2,1 | 1 |
| **B7032-E-T-P4S** | | 5,01 | 160 | 240 | 38 | 2,1 | 2,1 | 25 | 174 | 228 | 2,1 | 1 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 157,4 | 152,6 | 161,3 | 161,3 | 58000 | 49500 | 10000 | 15000 | 525 | 1398 | 2957 | 1563 | 4329 | 9590 | 142 | 211 | 294 |
| 157,4 | 152,6 | 161,3 | 161,3 | 55000 | 47500 | 9500 | 14000 | 750 | 1972 | 4124 | 2168 | 5811 | 12435 | 282 | 402 | 535 |
| 157,4 | 152,6 | 161,3 | 161,3 | 58000 | 47500 | 12000 | 16000 | 369 | 976 | 2055 | 1081 | 2948 | 6431 | 140 | 204 | 278 |
| 157,4 | 152,6 | 161,3 | 161,3 | 55000 | 45500 | 12000 | 16000 | 529 | 1387 | 2889 | 1519 | 4038 | 8558 | 282 | 398 | 523 |
| 157,4 | 152,6 | 161,3 | 161,3 | 139000 | 67000 | 13000 | 16000 | 331 | 875 | 1839 | 967 | 2626 | 5703 | 139 | 201 | 272 |
| 157,4 | 152,6 | 161,3 | 161,3 | 132000 | 63000 | 12000 | 16000 | 475 | 1245 | 2592 | 1363 | 3615 | 7643 | 281 | 395 | 518 |
| 160,9 | 160,9 | 172 | 172 | 215000 | 151000 | 5600 | 8500 | 1306 | 4034 | 7993 | 4018 | 13354 | 28189 | 147 | 244 | 344 |
| 160,9 | 160,9 | 172 | 172 | 205000 | 144000 | 5000 | 7500 | 2065 | 6617 | 13506 | 6015 | 19876 | 41831 | 353 | 549 | 735 |
| 160,9 | 160,9 | 172 | 172 | 215000 | 144000 | 7000 | 11000 | 716 | 2288 | 4642 | 2132 | 7184 | 15307 | 129 | 208 | 288 |
| 160,9 | 160,9 | 172 | 172 | 205000 | 138000 | 6000 | 9000 | 1098 | 3687 | 7648 | 3160 | 10826 | 22934 | 318 | 493 | 652 |
| 155,5 | 155,5 | 160,6 | 160,6 | 94000 | 77000 | 6700 | 10000 | 504 | 1632 | 3289 | 1539 | 5357 | 11496 | 124 | 208 | 295 |
| 155,5 | 155,5 | 160,6 | 160,6 | 89000 | 73000 | 6000 | 9500 | 736 | 2564 | 5373 | 2136 | 7663 | 16542 | 292 | 466 | 628 |
| 155,5 | 155,5 | 160,6 | 160,6 | 94000 | 74000 | 9500 | 14000 | 259 | 901 | 1876 | 767 | 2806 | 6135 | 107 | 177 | 246 |
| 155,5 | 155,5 | 160,6 | 160,6 | 89000 | 70000 | 8500 | 13000 | 348 | 1367 | 2967 | 999 | 3997 | 8852 | 253 | 413 | 554 |
| 161,6 | 161,6 | 169,2 | 169,2 | 153000 | 114000 | 6300 | 10000 | 866 | 2724 | 5429 | 2661 | 9007 | 19129 | 142 | 237 | 335 |
| 161,6 | 161,6 | 169,2 | 169,2 | 145000 | 108000 | 5600 | 9000 | 1336 | 4416 | 9103 | 3888 | 13252 | 28168 | 339 | 532 | 714 |
| 161,6 | 161,6 | 169,2 | 169,2 | 153000 | 109000 | 9000 | 14000 | 471 | 1553 | 3179 | 1402 | 4871 | 10483 | 125 | 203 | 282 |
| 161,6 | 161,6 | 169,2 | 169,2 | 145000 | 103000 | 8000 | 12000 | 685 | 2429 | 5123 | 1968 | 7126 | 15352 | 302 | 476 | 633 |
| 175,9 | 175,9 | 187 | 187 | 224000 | 164000 | 5000 | 7500 | 1353 | 4185 | 8302 | 4158 | 13825 | 29200 | 155 | 257 | 362 |
| 175,9 | 175,9 | 187 | 187 | 213000 | 157000 | 4500 | 6700 | 2141 | 6870 | 14029 | 6233 | 20615 | 43390 | 373 | 579 | 775 |
| 175,9 | 175,9 | 187 | 187 | 224000 | 157000 | 6300 | 9500 | 749 | 2397 | 4864 | 2230 | 7516 | 16017 | 137 | 220 | 304 |
| 175,9 | 175,9 | 187 | 187 | 214000 | 150000 | 5300 | 8000 | 1141 | 3839 | 7968 | 3284 | 11267 | 23876 | 336 | 521 | 689 |
| 168,6 | 168,6 | 174,9 | 174,9 | 119000 | 95000 | 5600 | 8500 | 1040 | 3522 | 7317 | 3021 | 10536 | 22549 | 331 | 524 | 704 |
| 168,6 | 168,6 | 174,9 | 174,9 | 125000 | 101000 | 6300 | 9500 | 706 | 2249 | 4507 | 2161 | 7402 | 15795 | 141 | 235 | 333 |
| 168,6 | 168,6 | 174,9 | 174,9 | 126000 | 96000 | 8500 | 13000 | 376 | 1268 | 2617 | 1117 | 3963 | 8587 | 123 | 201 | 279 |
| 168,6 | 168,6 | 174,9 | 174,9 | 119000 | 91000 | 7500 | 12000 | 527 | 1950 | 4164 | 1513 | 5709 | 12445 | 294 | 470 | 627 |
| 172,2 | 172,2 | 181 | 181 | 187000 | 137000 | 6000 | 9000 | 1104 | 3443 | 6843 | 3394 | 11397 | 24140 | 156 | 260 | 367 |
| 172,2 | 172,2 | 181 | 181 | 178000 | 130000 | 5300 | 8000 | 1691 | 5520 | 11332 | 4923 | 16566 | 35067 | 371 | 580 | 778 |
| 172,2 | 172,2 | 181 | 181 | 188000 | 131000 | 8000 | 13000 | 602 | 1958 | 3992 | 1793 | 6146 | 13171 | 137 | 222 | 308 |
| 172,2 | 172,2 | 181 | 181 | 178000 | 125000 | 7500 | 11000 | 889 | 3079 | 6448 | 2556 | 9036 | 19329 | 333 | 522 | 692 |
| 190,9 | 190,9 | 201,9 | 201,9 | 232000 | 178000 | 4500 | 6700 | 1401 | 4337 | 8611 | 4299 | 14296 | 30211 | 163 | 269 | 380 |
| 190,9 | 190,9 | 201,9 | 201,9 | 221000 | 169000 | 4000 | 6000 | 2173 | 6987 | 14280 | 6322 | 20936 | 44075 | 390 | 605 | 808 |
| 190,9 | 190,9 | 201,9 | 201,9 | 232000 | 170000 | 6000 | 8500 | 761 | 2440 | 4958 | 2262 | 7633 | 16272 | 143 | 230 | 317 |
| 190,9 | 190,9 | 201,9 | 201,9 | 221000 | 162000 | 5000 | 7500 | 1167 | 3935 | 8175 | 3355 | 11539 | 24467 | 352 | 546 | 722 |
| 179,5 | 179,5 | 184,7 | 184,7 | 128000 | 106000 | 6000 | 9000 | 722 | 2304 | 4619 | 2209 | 7572 | 16164 | 145 | 243 | 344 |
| 179,5 | 179,5 | 184,7 | 184,7 | 121000 | 100000 | 5300 | 8000 | 1055 | 3579 | 7439 | 3062 | 10696 | 22899 | 341 | 539 | 725 |
| 179,5 | 179,5 | 184,7 | 184,7 | 128000 | 101000 | 8000 | 12000 | 374 | 1265 | 2614 | 1108 | 3944 | 8551 | 126 | 206 | 285 |
| 179,5 | 179,5 | 184,7 | 184,7 | 121000 | 96000 | 7500 | 11000 | 521 | 1940 | 4152 | 1495 | 5676 | 12392 | 301 | 481 | 642 |
| 184,7 | 184,7 | 193,4 | 193,4 | 192000 | 146000 | 5600 | 8500 | 1145 | 3574 | 7107 | 3520 | 11821 | 25044 | 163 | 271 | 384 |
| 184,7 | 184,7 | 193,4 | 193,4 | 182000 | 138000 | 5000 | 7500 | 1715 | 5606 | 11519 | 4988 | 16807 | 35587 | 385 | 601 | 806 |

## 2.2.2 Spindle bearings

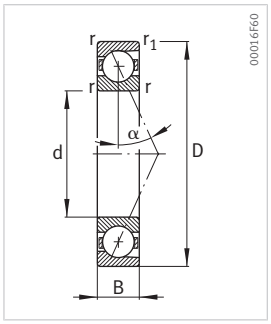
With large, medium or small balls

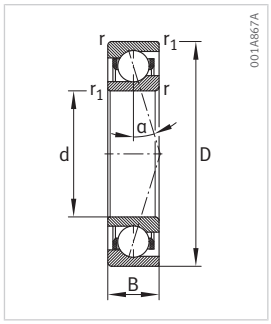
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

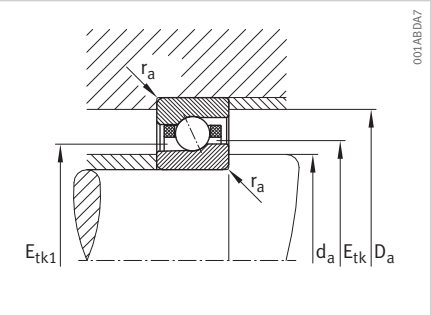
sealed



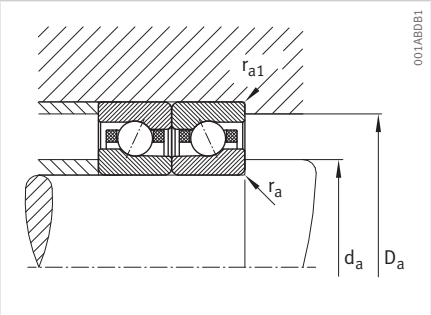




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCB7032-C-T-P4S** | | 4,2 | 160 | 240 | 38 | 2,1 | 2,1 | 15 | 174 | 228 | 2,1 | 1 |
| **HCB7032-E-T-P4S** | | 4,18 | 160 | 240 | 38 | 2,1 | 2,1 | 25 | 174 | 228 | 2,1 | 1 |
| **B7232-C-T-P4S** | | 12,9 | 160 | 290 | 48 | 3 | 3 | 15 | 191 | 259 | 2,5 | 2,5 |
| **B7232-E-T-P4S** | | 12,9 | 160 | 290 | 48 | 3 | 3 | 25 | 191 | 259 | 2,5 | 2,5 |
| **HCB7232-C-T-P4S** | | 11,4 | 160 | 290 | 48 | 3 | 3 | 15 | 191 | 259 | 2,5 | 2,5 |
| **HCB7232-E-T-P4S** | | 11,4 | 160 | 290 | 48 | 3 | 3 | 25 | 191 | 259 | 2,5 | 2,5 |
| **B71934-C-T-P4S** | • | 2,79 | 170 | 230 | 28 | 2 | 1 | 15 | 180 | 219 | 1 | 1 |
| **B71934-E-T-P4S** | • | 2,78 | 170 | 230 | 28 | 2 | 1 | 25 | 180 | 219 | 1 | 1 |
| **HCB71934-C-T-P4S** | • | 2,33 | 170 | 230 | 28 | 2 | 1 | 15 | 180 | 219 | 1 | 1 |
| **HCB71934-E-T-P4S** | • | 2,32 | 170 | 230 | 28 | 2 | 1 | 25 | 180 | 219 | 1 | 1 |
| **B7034-C-T-P4S** | | 6,52 | 170 | 260 | 42 | 2,1 | 2,1 | 15 | 185 | 246 | 2,1 | 1 |
| **B7034-E-T-P4S** | | 6,49 | 170 | 260 | 42 | 2,1 | 2,1 | 25 | 185 | 246 | 2,1 | 1 |
| **B7234-C-T-P4S** | | 15,7 | 170 | 310 | 52 | 4 | 4 | 15 | 205 | 275 | 3 | 3 |
| **B7234-E-T-P4S** | | 15,6 | 170 | 310 | 52 | 4 | 4 | 25 | 205 | 275 | 3 | 3 |
| **B71936-C-T-P4S** | | 4,14 | 180 | 250 | 33 | 2 | 1 | 15 | 192 | 238 | 1 | 1 |
| **B71936-E-T-P4S** | | 4,12 | 180 | 250 | 33 | 2 | 1 | 25 | 192 | 238 | 1 | 1 |
| **HCB71936-C-T-P4S** | | 3,45 | 180 | 250 | 33 | 2 | 1 | 15 | 192 | 238 | 1 | 1 |
| **HCB71936-E-T-P4S** | | 3,43 | 180 | 250 | 33 | 2 | 1 | 25 | 192 | 238 | 1 | 1 |
| **B7036-C-T-P4S** | | 8,79 | 180 | 280 | 46 | 2,1 | 2,1 | 15 | 196 | 264 | 2,1 | 1 |
| **B7036-E-T-P4S** | | 8,76 | 180 | 280 | 46 | 2,1 | 2,1 | 25 | 196 | 264 | 2,1 | 1 |
| **B7236-C-T-P4S** | | 16,4 | 180 | 320 | 52 | 4 | 4 | 15 | 213,5 | 286,5 | 3 | 3 |
| **B7236-E-T-P4S** | | 16,3 | 180 | 320 | 52 | 4 | 4 | 25 | 213,5 | 286,5 | 3 | 3 |
| **B71938-C-T-P4S** | | 4,33 | 190 | 260 | 33 | 2 | 1 | 15 | 202 | 247 | 1 | 1 |
| **B71938-E-T-P4S** | | 4,31 | 190 | 260 | 33 | 2 | 1 | 25 | 202 | 247 | 1 | 1 |
| **HCB71938-C-T-P4S** | | 3,6 | 190 | 260 | 33 | 2 | 1 | 15 | 202 | 247 | 1 | 1 |
| **HCB71938-E-T-P4S** | | 3,58 | 190 | 260 | 33 | 2 | 1 | 25 | 202 | 247 | 1 | 1 |
| **B7038-C-T-P4S** | | 9,2 | 190 | 290 | 46 | 2,1 | 2,1 | 15 | 206 | 274 | 2,1 | 1 |
| **B7038-E-T-P4S** | | 9,16 | 190 | 290 | 46 | 2,1 | 2,1 | 25 | 206 | 274 | 2,1 | 1 |
| **B7238-C-T-P4S** | | 20 | 190 | 340 | 55 | 4 | 4 | 15 | 223,5 | 306,5 | 3 | 3 |
| **B7238-E-T-P4S** | | 20 | 190 | 340 | 55 | 4 | 4 | 25 | 223,5 | 306,5 | 3 | 3 |
| **B71940-C-T-P4S** | | 6,05 | 200 | 280 | 38 | 2,1 | 1,1 | 15 | 214 | 266 | 1 | 1 |
| **B71940-E-T-P4S** | | 6,03 | 200 | 280 | 38 | 2,1 | 1,1 | 25 | 214 | 266 | 1 | 1 |
| **HCB71940-C-T-P4S** | | 5,07 | 200 | 280 | 38 | 2,1 | 1,1 | 15 | 214 | 266 | 1 | 1 |
| **HCB71940-E-T-P4S** | | 5,04 | 200 | 280 | 38 | 2,1 | 1,1 | 25 | 214 | 266 | 1 | 1 |
| **B7040-C-T-P4S** | | 11,6 | 200 | 310 | 51 | 2,1 | 2,1 | 15 | 217 | 293 | 2,1 | 1 |
| **B7040-E-T-P4S** | | 11,6 | 200 | 310 | 51 | 2,1 | 2,1 | 25 | 217 | 293 | 2,1 | 1 |
| **B7240-C-T-P4S** | | 24,2 | 200 | 360 | 58 | 4 | 4 | 15 | 238,5 | 321,5 | 3 | 3 |
| **B7240-E-T-P4S** | | 24,2 | 200 | 360 | 58 | 4 | 4 | 25 | 238,5 | 321,5 | 3 | 3 |
| **B71944-C-T-P4S** | | 6,6 | 220 | 300 | 38 | 2,1 | 1,1 | 15 | 234 | 286 | 1 | 1 |
| **B71944-E-T-P4S** | | 6,58 | 220 | 300 | 38 | 2,1 | 1,1 | 25 | 234 | 286 | 1 | 1 |




Mounting dimensions




Mounting dimensions

| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 184,7 | 184,7 | 193,4 | 193,4 | 193000 | 140000 | 7500 | 12000 | 609 | 1986 | 4053 | 1812 | 6221 | 13337 | 142 | 230 | 318 |
| 184,7 | 184,7 | 193,4 | 193,4 | 183000 | 132000 | 7000 | 11000 | 898 | 3121 | 6545 | 2581 | 9154 | 19595 | 345 | 541 | 717 |
| 205,9 | 205,9 | 216,9 | 216,9 | 249000 | 202000 | 4300 | 6300 | 1502 | 4659 | 9263 | 4601 | 15309 | 32375 | 179 | 295 | 416 |
| 205,9 | 205,9 | 216,9 | 216,9 | 236000 | 192000 | 3800 | 5600 | 2326 | 7493 | 15324 | 6760 | 22418 | 47204 | 429 | 665 | 888 |
| 205,9 | 205,9 | 216,9 | 216,9 | 249000 | 193000 | 5300 | 8000 | 827 | 2657 | 5402 | 2457 | 8298 | 17692 | 158 | 254 | 350 |
| 205,9 | 205,9 | 216,9 | 216,9 | 237000 | 184000 | 4500 | 6700 | 1235 | 4183 | 8703 | 3550 | 12254 | 26003 | 387 | 599 | 792 |
| 188,6 | 188,6 | 194,7 | 194,7 | 133000 | 115000 | 5600 | 8500 | 742 | 2375 | 4770 | 2266 | 7779 | 16624 | 154 | 256 | 362 |
| 188,6 | 188,6 | 194,7 | 194,7 | 126000 | 108000 | 5000 | 7500 | 1105 | 3757 | 7816 | 3206 | 11221 | 24031 | 364 | 575 | 773 |
| 188,6 | 188,6 | 194,7 | 194,7 | 133000 | 110000 | 7500 | 12000 | 385 | 1306 | 2703 | 1138 | 4063 | 8815 | 133 | 217 | 301 |
| 188,6 | 188,6 | 194,7 | 194,7 | 126000 | 104000 | 7000 | 11000 | 534 | 2004 | 4295 | 1533 | 5856 | 12804 | 318 | 510 | 681 |
| 195,9 | 195,9 | 206,9 | 206,9 | 241000 | 189000 | 5300 | 8000 | 1448 | 4488 | 8919 | 4439 | 14768 | 31222 | 171 | 282 | 397 |
| 195,9 | 195,9 | 206,9 | 206,9 | 229000 | 180000 | 4500 | 7000 | 2250 | 7240 | 14802 | 6541 | 21677 | 45639 | 409 | 635 | 848 |
| 217,1 | 217,1 | 230,4 | 230,4 | 300000 | 255000 | 3800 | 5600 | 1864 | 5749 | 11422 | 5698 | 18828 | 39747 | 189 | 311 | 436 |
| 217,1 | 217,1 | 230,4 | 230,4 | 285000 | 241000 | 3600 | 5300 | 2860 | 9126 | 18610 | 8307 | 27255 | 57164 | 452 | 699 | 930 |
| 201,6 | 201,6 | 209 | 209 | 171000 | 146000 | 5300 | 8000 | 960 | 3036 | 6076 | 2933 | 9953 | 21191 | 168 | 279 | 394 |
| 201,6 | 201,6 | 209 | 209 | 162000 | 138000 | 4500 | 7000 | 1468 | 4890 | 10108 | 4263 | 14618 | 31112 | 402 | 630 | 845 |
| 201,6 | 201,6 | 209 | 209 | 171000 | 139000 | 7000 | 11000 | 519 | 1726 | 3546 | 1540 | 5380 | 11597 | 148 | 240 | 332 |
| 201,6 | 201,6 | 209 | 209 | 162000 | 132000 | 6300 | 10000 | 731 | 2635 | 5587 | 2098 | 7710 | 16669 | 354 | 561 | 746 |
| 210,9 | 210,9 | 221,9 | 221,9 | 248000 | 203000 | 4800 | 7500 | 1502 | 4659 | 9263 | 4601 | 15309 | 32375 | 179 | 295 | 416 |
| 210,9 | 210,9 | 221,9 | 221,9 | 236000 | 193000 | 4300 | 6700 | 2326 | 7493 | 15324 | 6760 | 22418 | 47204 | 429 | 665 | 888 |
| 227,1 | 227,1 | 240,4 | 240,4 | 310000 | 270000 | 3800 | 5600 | 1891 | 5843 | 11625 | 5771 | 19076 | 40296 | 197 | 323 | 453 |
| 227,1 | 227,1 | 240,4 | 240,4 | 295000 | 260000 | 3400 | 5000 | 2957 | 9444 | 19266 | 8585 | 28184 | 59117 | 475 | 733 | 976 |
| 211,6 | 211,6 | 218,9 | 218,9 | 174000 | 152000 | 5000 | 7500 | 888 | 2947 | 5992 | 2700 | 9612 | 20790 | 166 | 281 | 398 |
| 211,6 | 211,6 | 218,9 | 218,9 | 164000 | 144000 | 4500 | 6700 | 1250 | 4547 | 9653 | 3619 | 13545 | 29595 | 388 | 627 | 847 |
| 211,6 | 211,6 | 218,9 | 218,9 | 174000 | 146000 | 6700 | 10000 | 450 | 1629 | 3436 | 1328 | 5053 | 11178 | 143 | 239 | 334 |
| 211,6 | 211,6 | 218,9 | 218,9 | 165000 | 138000 | 6000 | 9500 | 557 | 2383 | 5290 | 1596 | 6951 | 15738 | 331 | 554 | 747 |
| 220,9 | 220,9 | 231,8 | 231,8 | 255000 | 215000 | 4500 | 7000 | 1436 | 4599 | 9248 | 4377 | 15038 | 32154 | 181 | 302 | 426 |
| 220,9 | 220,9 | 231,8 | 231,8 | 243000 | 204000 | 4000 | 6300 | 2128 | 7254 | 15104 | 6172 | 21646 | 46379 | 429 | 678 | 910 |
| 242,1 | 242,1 | 255,3 | 255,3 | 320000 | 290000 | 3400 | 5000 | 1846 | 5864 | 11779 | 5614 | 19073 | 40669 | 201 | 333 | 468 |
| 242,1 | 242,1 | 255,3 | 255,3 | 305000 | 275000 | 3200 | 4800 | 2797 | 9366 | 19397 | 8105 | 27894 | 59391 | 482 | 755 | 1010 |
| 224,7 | 224,7 | 233,1 | 233,1 | 210000 | 179000 | 4500 | 7000 | 1127 | 3678 | 7439 | 3433 | 12027 | 25875 | 180 | 302 | 427 |
| 224,7 | 224,7 | 233,1 | 233,1 | 199000 | 170000 | 4000 | 6300 | 1635 | 5765 | 12127 | 4737 | 17199 | 37246 | 423 | 676 | 911 |
| 224,7 | 224,7 | 233,1 | 233,1 | 211000 | 171000 | 6300 | 10000 | 571 | 2012 | 4211 | 1688 | 6249 | 13711 | 154 | 256 | 355 |
| 224,7 | 224,7 | 233,1 | 233,1 | 199000 | 162000 | 5600 | 9000 | 768 | 3083 | 6732 | 2202 | 9005 | 20060 | 366 | 601 | 806 |
| 232,1 | 232,1 | 245,4 | 245,4 | 310000 | 270000 | 4300 | 6700 | 1791 | 5681 | 11402 | 5451 | 18508 | 39448 | 192 | 318 | 448 |
| 232,1 | 232,1 | 245,4 | 245,4 | 295000 | 260000 | 3800 | 6000 | 2711 | 9065 | 18765 | 7860 | 27018 | 57509 | 460 | 722 | 965 |
| 257,1 | 257,1 | 270,1 | 270,1 | 330000 | 310000 | 3200 | 4800 | 1902 | 6047 | 12156 | 5777 | 19638 | 41892 | 210 | 347 | 488 |
| 257,1 | 257,1 | 270,1 | 270,1 | 315000 | 295000 | 3000 | 4500 | 2882 | 9666 | 20030 | 8349 | 28771 | 61275 | 503 | 789 | 1055 |
| 244,7 | 244,7 | 253,1 | 253,1 | 224000 | 203000 | 4300 | 6700 | 1185 | 3886 | 7879 | 3600 | 12649 | 27258 | 196 | 329 | 465 |
| 244,7 | 244,7 | 253,1 | 253,1 | 212000 | 192000 | 3800 | 6000 | 1705 | 6060 | 12777 | 4937 | 18042 | 39132 | 461 | 739 | 995 |

## 2.2.2 Spindle bearings

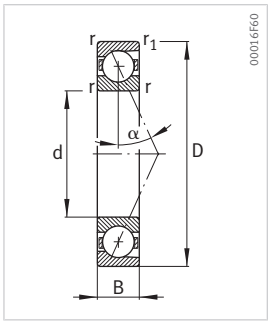
With large, medium or small balls

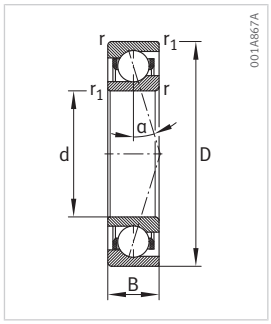
Steel balls or ceramic balls

Steel rings or Vacrodur rings

open

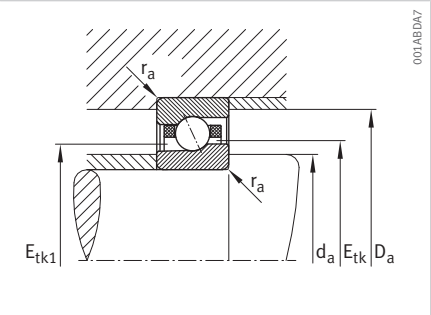
sealed



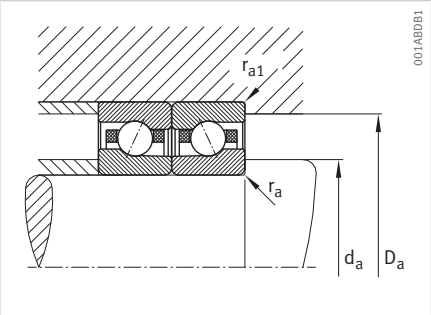




M719, HCM719, VCM719

| Short designation | Sealed variants (•) | m | d | D | B | r min | $r_1$ min | α | $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ➤93\|⧉56 | kg | mm | mm | mm | mm | mm | ° | mm | mm | mm | mm |
| **HCB71944-C-T-P4S** | | 5,49 | 220 | 300 | 38 | 2,1 | 1,1 | 15 | 234 | 286 | 1 | 1 |
| **HCB71944-E-T-P4S** | | 5,47 | 220 | 300 | 38 | 2,1 | 1,1 | 25 | 234 | 286 | 1 | 1 |
| **B7044-C-T-P4S** | | 15,7 | 220 | 340 | 56 | 3 | 3 | 15 | 239 | 321 | 2,5 | 1 |
| **B7044-E-T-P4S** | | 15,7 | 220 | 340 | 56 | 3 | 3 | 25 | 239 | 321 | 2,5 | 1 |
| **B7244-C-T-P4S** | | 33,1 | 220 | 400 | 65 | 4 | 4 | 15 | 264 | 356 | 3 | 3 |
| **B7244-E-T-P4S** | | 33,1 | 220 | 400 | 65 | 4 | 4 | 25 | 264 | 356 | 3 | 3 |
| **B71948-C-T-P4S** | | 7,1 | 240 | 320 | 38 | 2,1 | 1,1 | 15 | 254 | 307 | 1 | 1 |
| **B71948-E-T-P4S** | | 7,08 | 240 | 320 | 38 | 2,1 | 1,1 | 25 | 254 | 307 | 1 | 1 |
| **B7048-C-T-P4S** | | 16,8 | 240 | 360 | 56 | 3 | 3 | 15 | 260 | 341 | 2,5 | 1 |
| **B7048-E-T-P4S** | | 16,7 | 240 | 360 | 56 | 3 | 3 | 25 | 260 | 341 | 2,5 | 1 |
| **B71952-C-T-P4S** | | 12 | 260 | 360 | 46 | 2,1 | 1,1 | 15 | 278 | 342 | 1 | 1 |
| **B71956-C-T-P4S** | | 12,9 | 280 | 380 | 46 | 2,1 | 1,1 | 15 | 298 | 362 | 1 | 1 |
| **B71960-C-T-P4S** | | 20 | 300 | 420 | 56 | 3 | 1,1 | 15 | 322 | 398 | 1 | 1 |




Mounting dimensions




Mounting dimensions

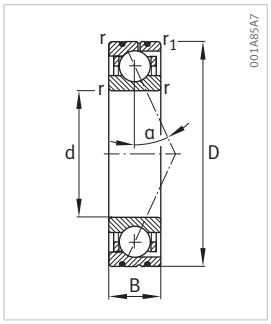
| $E_{tk}$ min. | $E_{tk1}$ min. | $E_{tk}$ max. | $E_{tk1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 244,7 | 244,7 | 253,1 | 253,1 | 224000 | 194000 | 6000 | 9000 | 606 | 2147 | 4503 | 1788 | 6651 | 14612 | 169 | 280 | 390 |
| 244,7 | 244,7 | 253,1 | 253,1 | 212000 | 184000 | 5300 | 8000 | 779 | 3184 | 6985 | 2232 | 9284 | 20766 | 396 | 653 | 877 |
| 257,1 | 257,1 | 270,1 | 270,1 | 330000 | 310000 | 4000 | 6000 | 1902 | 6047 | 12156 | 5777 | 19638 | 41892 | 210 | 347 | 488 |
| 257,1 | 257,1 | 270,1 | 270,1 | 315000 | 295000 | 3600 | 5300 | 2882 | 9666 | 20030 | 8349 | 28771 | 61275 | 503 | 789 | 1055 |
| 282,3 | 282,3 | 298,2 | 298,2 | 405000 | 400000 | 2800 | 4300 | 2387 | 7527 | 15105 | 7238 | 24345 | 51776 | 224 | 368 | 515 |
| 282,3 | 282,3 | 298,2 | 298,2 | 385000 | 380000 | 2600 | 4000 | 3642 | 12021 | 24787 | 10546 | 35720 | 75626 | 540 | 840 | 1119 |
| 264,7 | 264,7 | 272,9 | 272,9 | 231000 | 220000 | 4000 | 6000 | 1224 | 4024 | 8171 | 3712 | 13066 | 28181 | 207 | 347 | 490 |
| 264,7 | 264,7 | 272,9 | 272,9 | 218000 | 208000 | 3600 | 5300 | 1760 | 6279 | 13255 | 5092 | 18673 | 40536 | 488 | 781 | 1052 |
| 277,1 | 277,1 | 290 | 290 | 340000 | 330000 | 3600 | 5600 | 1957 | 6231 | 12533 | 5940 | 20205 | 43114 | 219 | 361 | 507 |
| 277,1 | 277,1 | 290 | 290 | 320000 | 310000 | 3200 | 5000 | 2914 | 9801 | 20327 | 8437 | 29140 | 62090 | 521 | 817 | 1092 |
| 290,9 | 290,9 | 301,4 | 301,4 | 295000 | 290000 | 3600 | 5300 | 1615 | 5221 | 10556 | 4894 | 16900 | 36243 | 222 | 368 | 518 |
| 310,9 | 310,9 | 321,2 | 321,2 | 305000 | 320000 | 3200 | 5000 | 1696 | 5491 | 11113 | 5134 | 17744 | 38073 | 236 | 392 | 551 |
| 337,1 | 337,1 | 349,7 | 349,7 | 370000 | 405000 | 3000 | 4500 | 2084 | 6676 | 13480 | 6297 | 21485 | 45930 | 249 | 409 | 574 |

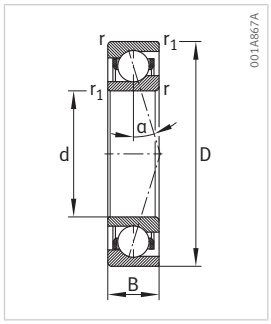
## 2.2.3 Spindle bearings, design DLR

With large, medium or small balls

Ceramic balls

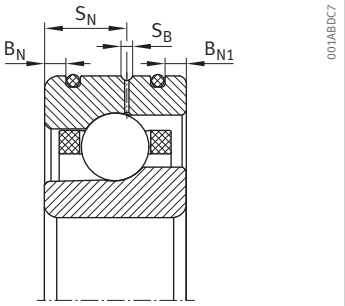
Steel rings or Vacrodur rings

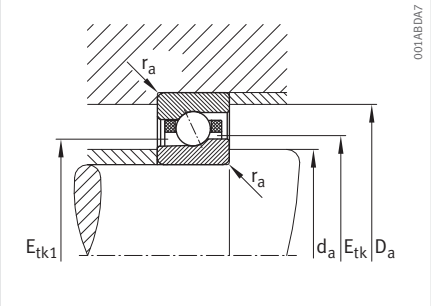


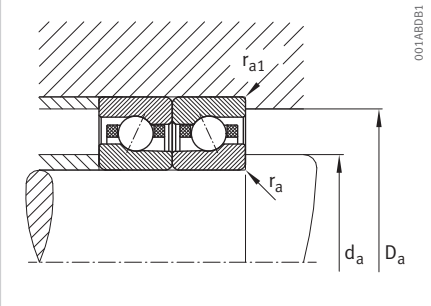

M719, HCM719, VCM719

| Short designation | m | d | D | B | r min | $r_1$ min | $B_N$ | $B_{N1}$ | $S_N$ | $S_B$ | α | $d_a$ h12 | $D_a$ H12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm | mm | mm | ° | mm | mm |
| **HCB71910-CDLR-T-P4S** | 0,102 | 50 | 72 | 12 | 0,6 | 0,6 | 2,2 | 2,2 | 6,6 | 1,4 | 15 | 55 | 67,5 |
| **HCB71910-EDLR-T-P4S** | 0,102 | 50 | 72 | 12 | 0,6 | 0,6 | 2,2 | 2,2 | 6,6 | 1,4 | 25 | 55 | 67,5 |
| **HC71910-EDLR-T-P4S** | 0,13 | 50 | 72 | 12 | 0,6 | 0,6 | 2,2 | 2,2 | 6,6 | 1,4 | 25 | 55 | 67,5 |
| **HCM71910-CDLR-T-P4S-XL** | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 2,2 | 1,7 | 7 | 1,4 | 17 | 55 | 67,5 |
| **HCM71910-EDLR-T-P4S-XL** | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 2,2 | 1,7 | 7 | 1,4 | 25 | 55 | 67,5 |
| **VCM71910-CDLR-T-P4S-XL** | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 2,2 | 1,7 | 7 | 1,4 | 17 | 55 | 67,5 |
| **VCM71910-EDLR-T-P4S-XL** | 0,11 | 50 | 72 | 12 | 0,6 | 0,3 | 2,2 | 1,7 | 7 | 1,4 | 25 | 55 | 67,5 |
| **HCB7010-CDLR-T-P4S** | 0,205 | 50 | 80 | 16 | 1 | 1 | 3,4 | 3,4 | 9,3 | 1,4 | 15 | 56 | 74 |
| **HCB7010-EDLR-T-P4S** | 0,206 | 50 | 80 | 16 | 1 | 1 | 3,4 | 3,4 | 9,3 | 1,4 | 25 | 56 | 74 |
| **HC7010-EDLR-T-P4S** | 0,262 | 50 | 80 | 16 | 1 | 1 | 3,4 | 3,4 | 9,3 | 1,4 | 25 | 56 | 74 |
| **HCM7010-CDLR-T-P4S-XL** | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 2,6 | 2,6 | 9,3 | 1,4 | 17 | 56 | 74 |
| **HCM7010-EDLR-T-P4S-XL** | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 2,6 | 2,6 | 9,3 | 1,4 | 25 | 56 | 74 |
| **VCM7010-CDLR-T-P4S-XL** | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 2,6 | 2,6 | 9,3 | 1,4 | 17 | 56 | 74 |
| **VCM7010-EDLR-T-P4S-XL** | 0,26 | 50 | 80 | 16 | 1 | 0,6 | 2,6 | 2,6 | 9,3 | 1,4 | 25 | 56 | 74 |
| **HCB71911-CDLR-T-P4S** | 0,14 | 55 | 80 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 15 | 60 | 75,5 |
| **HCB71911-EDLR-T-P4S** | 0,14 | 55 | 80 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 25 | 60 | 75,5 |
| **HC71911-EDLR-T-P4S** | 0,166 | 55 | 80 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 25 | 60 | 75,5 |
| **HCM71911-CDLR-T-P4S-XL** | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 17 | 60 | 75,5 |
| **HCM71911-EDLR-T-P4S-XL** | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 25 | 60 | 75,5 |
| **VCM71911-CDLR-T-P4S-XL** | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 17 | 60 | 75,5 |
| **VCM71911-EDLR-T-P4S-XL** | 0,13 | 55 | 80 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 25 | 60 | 75,5 |
| **HCB7011-CDLR-T-P4S** | 0,302 | 55 | 90 | 18 | 1,1 | 1,1 | 4,3 | 4,3 | 9,7 | 1,4 | 15 | 62 | 83 |
| **HCB7011-EDLR-T-P4S** | 0,302 | 55 | 90 | 18 | 1,1 | 1,1 | 4,3 | 4,3 | 9,7 | 1,4 | 25 | 62 | 83 |
| **HC7011-EDLR-T-P4S** | 0,378 | 55 | 90 | 18 | 1,1 | 1,1 | 4,3 | 4,3 | 9,7 | 1,4 | 25 | 62 | 83 |
| **HCM7011-CDLR-T-P4S-XL** | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 17 | 62 | 83 |
| **HCM7011-EDLR-T-P4S-XL** | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 25 | 62 | 83 |
| **VCM7011-CDLR-T-P4S-XL** | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 17 | 62 | 83 |
| **VCM7011-EDLR-T-P4S-XL** | 0,36 | 55 | 90 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 25 | 62 | 83 |
| **HCB71912-CDLR-T-P4S** | 0,151 | 60 | 85 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 15 | 65 | 80,5 |
| **HCB71912-EDLR-T-P4S** | 0,151 | 60 | 85 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 25 | 65 | 80,5 |
| **HC71912-EDLR-T-P4S** | 0,18 | 60 | 85 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 25 | 65 | 80,5 |
| **HCM71912-CDLR-T-P4S-XL** | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 17 | 65 | 80,5 |
| **HCM71912-EDLR-T-P4S-XL** | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 25 | 65 | 80,5 |
| **VCM71912-CDLR-T-P4S-XL** | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 17 | 65 | 80,5 |
| **VCM71912-EDLR-T-P4S-XL** | 0,14 | 60 | 85 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 25 | 65 | 80,5 |
| **HCB7012-CDLR-T-P4S** | 0,326 | 60 | 95 | 18 | 1,1 | 1,1 | 4,3 | 4,3 | 9,7 | 1,4 | 15 | 67 | 88 |
| **HCB7012-EDLR-T-P4S** | 0,326 | 60 | 95 | 18 | 1,1 | 1,1 | 4,3 | 4,3 | 9,7 | 1,4 | 25 | 67 | 88 |
| **HC7012-EDLR-T-P4S** | 0,404 | 60 | 95 | 18 | 1,1 | 1,1 | 4,3 | 4,3 | 9,7 | 1,4 | 25 | 67 | 88 |
| **HCM7012-CDLR-T-P4S-XL** | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 17 | 67 | 88 |
| **HCM7012-EDLR-T-P4S-XL** | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 25 | 67 | 88 |




Mounting dimensions




Mounting dimensions

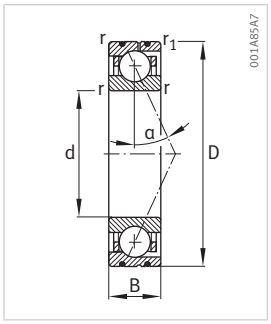
| $r_a$ max. | $r_{a1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 0,6 | 0,15 | 19600 | 11400 | 26000 | 40000 | 41 | 167 | 362 | 121 | 525 | 1205 | 38 | 66 | 95 |
| 0,6 | 0,15 | 18600 | 10800 | 24000 | 36000 | 40 | 229 | 542 | 115 | 671 | 1626 | 80 | 148 | 205 |
| 0,6 | 0,15 | 9400 | 5800 | 30000 | 48000 | 39 | 116 | 231 | 110 | 336 | 682 | 81 | 119 | 154 |
| 0,6 | 0,15 | 12900 | 6700 | 34000 | 50000 | 52 | 137 | 288 | 151 | 408 | 881 | 43 | 62 | 84 |
| 0,6 | 0,15 | 12300 | 6400 | 32000 | 45000 | 75 | 196 | 407 | 214 | 567 | 1194 | 88 | 123 | 161 |
| 0,6 | 0,15 | 31000 | 9400 | 34000 | 53000 | 47 | 123 | 258 | 135 | 364 | 784 | 43 | 62 | 82 |
| 0,6 | 0,15 | 29500 | 9000 | 32000 | 50000 | 67 | 176 | 365 | 192 | 508 | 1068 | 88 | 123 | 160 |
| 1 | 0,3 | 29000 | 15400 | 24000 | 38000 | 73 | 268 | 566 | 217 | 848 | 1894 | 44 | 75 | 107 |
| 1 | 0,3 | 27500 | 14700 | 22000 | 34000 | 90 | 400 | 895 | 259 | 1175 | 2697 | 100 | 171 | 234 |
| 1 | 0,3 | 12100 | 7400 | 28000 | 43000 | 50 | 149 | 298 | 143 | 435 | 883 | 90 | 133 | 172 |
| 1 | 0,3 | 13100 | 7100 | 32000 | 45000 | 55 | 144 | 303 | 159 | 430 | 928 | 45 | 65 | 88 |
| 1 | 0,3 | 12500 | 6700 | 30000 | 43000 | 79 | 206 | 429 | 225 | 596 | 1257 | 92 | 129 | 169 |
| 1 | 0,3 | 31500 | 9900 | 32000 | 50000 | 49 | 129 | 271 | 143 | 384 | 825 | 45 | 64 | 86 |
| 1 | 0,3 | 30000 | 9400 | 30000 | 45000 | 71 | 185 | 385 | 202 | 534 | 1124 | 92 | 128 | 167 |
| 0,6 | 0,3 | 23500 | 13800 | 24000 | 36000 | 53 | 208 | 447 | 157 | 654 | 1487 | 42 | 74 | 106 |
| 0,6 | 0,3 | 22300 | 13100 | 22000 | 32000 | 57 | 296 | 686 | 164 | 867 | 2058 | 93 | 167 | 230 |
| 0,6 | 0,3 | 12300 | 7700 | 28000 | 43000 | 51 | 152 | 304 | 145 | 442 | 897 | 93 | 137 | 177 |
| 0,6 | 0,3 | 18500 | 9500 | 30000 | 45000 | 73 | 194 | 406 | 213 | 576 | 1243 | 49 | 71 | 95 |
| 0,6 | 0,3 | 17700 | 9100 | 28000 | 43000 | 106 | 277 | 575 | 303 | 801 | 1687 | 100 | 140 | 183 |
| 0,6 | 0,3 | 44500 | 13300 | 32000 | 48000 | 66 | 174 | 363 | 191 | 514 | 1105 | 49 | 70 | 94 |
| 0,6 | 0,3 | 42500 | 12700 | 30000 | 45000 | 95 | 249 | 516 | 272 | 718 | 1509 | 100 | 139 | 182 |
| 1 | 0,6 | 39000 | 21200 | 22000 | 34000 | 102 | 366 | 765 | 305 | 1158 | 2559 | 52 | 88 | 124 |
| 1 | 0,6 | 37000 | 20100 | 20000 | 30000 | 136 | 562 | 1236 | 390 | 1653 | 3728 | 121 | 203 | 275 |
| 1 | 0,6 | 17000 | 10400 | 26000 | 40000 | 70 | 210 | 421 | 201 | 613 | 1244 | 105 | 155 | 201 |
| 1 | 0,6 | 19500 | 10500 | 28000 | 40000 | 81 | 214 | 450 | 236 | 638 | 1378 | 54 | 78 | 105 |
| 1 | 0,6 | 18600 | 10000 | 26000 | 38000 | 117 | 306 | 637 | 335 | 887 | 1869 | 110 | 154 | 201 |
| 1 | 0,6 | 46500 | 14700 | 28000 | 45000 | 73 | 192 | 403 | 212 | 570 | 1225 | 54 | 77 | 103 |
| 1 | 0,6 | 44500 | 14000 | 28000 | 40000 | 105 | 275 | 572 | 301 | 794 | 1671 | 109 | 153 | 200 |
| 0,6 | 0,3 | 24700 | 15300 | 22000 | 34000 | 54 | 214 | 462 | 159 | 671 | 1530 | 45 | 79 | 112 |
| 0,6 | 0,3 | 23400 | 14500 | 20000 | 30000 | 57 | 303 | 707 | 163 | 887 | 2118 | 99 | 179 | 246 |
| 0,6 | 0,3 | 12700 | 8300 | 26000 | 40000 | 52 | 155 | 311 | 148 | 452 | 917 | 98 | 144 | 186 |
| 0,6 | 0,3 | 19500 | 10500 | 28000 | 40000 | 81 | 214 | 450 | 236 | 638 | 1378 | 54 | 78 | 105 |
| 0,6 | 0,3 | 18600 | 10000 | 26000 | 38000 | 117 | 306 | 637 | 335 | 887 | 1869 | 110 | 154 | 201 |
| 0,6 | 0,3 | 46500 | 14700 | 28000 | 45000 | 73 | 192 | 403 | 212 | 570 | 1225 | 54 | 77 | 103 |
| 0,6 | 0,3 | 44500 | 14000 | 28000 | 40000 | 105 | 275 | 572 | 301 | 794 | 1671 | 109 | 153 | 200 |
| 1 | 0,6 | 40000 | 22700 | 20000 | 32000 | 106 | 379 | 794 | 315 | 1198 | 2651 | 54 | 92 | 130 |
| 1 | 0,6 | 38000 | 21600 | 19000 | 28000 | 136 | 569 | 1256 | 391 | 1673 | 3782 | 126 | 211 | 286 |
| 1 | 0,6 | 17600 | 11300 | 24000 | 36000 | 73 | 219 | 438 | 209 | 638 | 1294 | 112 | 165 | 213 |
| 1 | 0,6 | 19800 | 11100 | 26000 | 38000 | 86 | 226 | 474 | 249 | 673 | 1453 | 57 | 81 | 110 |
| 1 | 0,6 | 18900 | 10600 | 26000 | 36000 | 123 | 323 | 671 | 353 | 934 | 1968 | 115 | 161 | 211 |

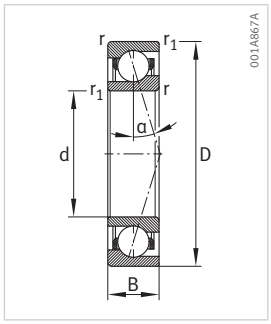
## 2.2.3 Spindle bearings, design DLR

With large, medium or small balls

Ceramic balls

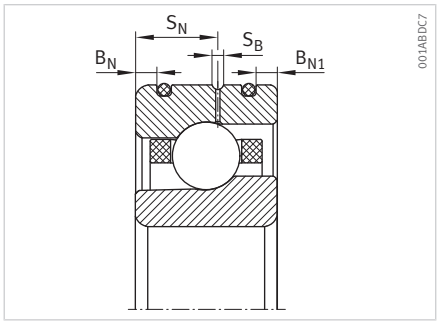
Steel rings or Vacrodur rings

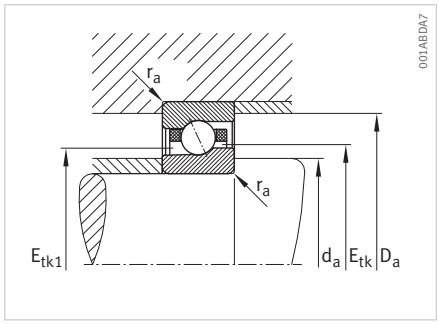


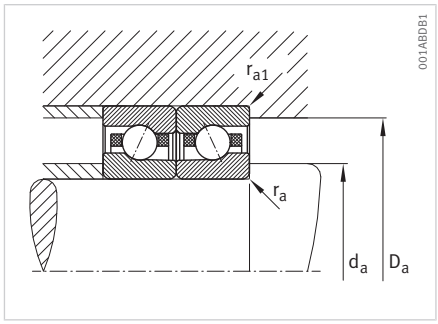

M719, HCM719, VCM719

| Short designation | m | d | D | B | r min | $r_1$ min | $B_N$ | $B_{N1}$ | $S_N$ | $S_B$ | α | $d_a$ h12 | $D_a$ H12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm | mm | mm | ° | mm | mm |
| **VCM7012-CDLR-T-P4S-XL** | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 17 | 67 | 88 |
| **VCM7012-EDLR-T-P4S-XL** | 0,39 | 60 | 95 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,15 | 1,4 | 25 | 67 | 88 |
| **HCB71913-CDLR-T-P4S** | 0,161 | 65 | 90 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 15 | 70 | 85,5 |
| **HCB71913-EDLR-T-P4S** | 0,161 | 65 | 90 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 25 | 70 | 85,5 |
| **HC71913-EDLR-T-P4S** | 0,19 | 65 | 90 | 13 | 1 | 1 | 2,8 | 2,8 | 7,2 | 1,4 | 25 | 70 | 85,5 |
| **HCM71913-CDLR-T-P4S-XL** | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 17 | 70 | 85,5 |
| **HCM71913-EDLR-T-P4S-XL** | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 25 | 70 | 85,5 |
| **VCM71913-CDLR-T-P4S-XL** | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 17 | 70 | 85,5 |
| **VCM71913-EDLR-T-P4S-XL** | 0,15 | 65 | 90 | 13 | 1 | 0,6 | 2,8 | 2 | 7,6 | 1,4 | 25 | 70 | 85,5 |
| **HCB7013-CDLR-T-P4S** | 0,343 | 65 | 100 | 18 | 1,1 | 1,1 | 4 | 4 | 10,4 | 1,4 | 15 | 72 | 93 |
| **HCB7013-EDLR-T-P4S** | 0,344 | 65 | 100 | 18 | 1,1 | 1,1 | 4 | 4 | 10,4 | 1,4 | 25 | 72 | 93 |
| **HC7013-EDLR-T-P4S** | 0,427 | 65 | 100 | 18 | 1,1 | 1,1 | 4 | 4 | 10,4 | 1,4 | 25 | 72 | 93 |
| **HCM7013-CDLR-T-P4S-XL** | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,4 | 1,4 | 17 | 72 | 93 |
| **HCM7013-EDLR-T-P4S-XL** | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,4 | 1,4 | 25 | 72 | 93 |
| **VCM7013-CDLR-T-P4S-XL** | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,4 | 1,4 | 17 | 72 | 93 |
| **VCM7013-EDLR-T-P4S-XL** | 0,41 | 65 | 100 | 18 | 1,1 | 0,6 | 2,8 | 2,8 | 10,4 | 1,4 | 25 | 72 | 93 |
| **HCB71914-CDLR-T-P4S** | 0,268 | 70 | 100 | 16 | 1 | 1 | 3,1 | 3,1 | 9,3 | 1,4 | 15 | 76 | 94,5 |
| **HCB71914-EDLR-T-P4S** | 0,268 | 70 | 100 | 16 | 1 | 1 | 3,1 | 3,1 | 9,3 | 1,4 | 25 | 76 | 94,5 |
| **HC71914-EDLR-T-P4S** | 0,322 | 70 | 100 | 16 | 1 | 1 | 3,1 | 3,1 | 9,3 | 1,4 | 25 | 76 | 94,5 |
| **HCM71914-CDLR-T-P4S-XL** | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 17 | 76 | 94,5 |
| **HCM71914-EDLR-T-P4S-XL** | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 25 | 76 | 94,5 |
| **VCM71914-CDLR-T-P4S-XL** | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 17 | 76 | 94,5 |
| **VCM71914-EDLR-T-P4S-XL** | 0,25 | 70 | 100 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 25 | 76 | 94,5 |
| **HCB7014-CDLR-T-P4S** | 0,48 | 70 | 110 | 20 | 1,1 | 1,1 | 4 | 4 | 11,6 | 1,4 | 15 | 77 | 102 |
| **HCB7014-EDLR-T-P4S** | 0,48 | 70 | 110 | 20 | 1,1 | 1,1 | 4 | 4 | 11,6 | 1,4 | 25 | 77 | 102 |
| **HC7014-EDLR-T-P4S** | 0,596 | 70 | 110 | 20 | 1,1 | 1,1 | 4 | 4 | 11,6 | 1,4 | 25 | 77 | 102 |
| **HCM7014-CDLR-T-P4S-XL** | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 3 | 3 | 11,6 | 1,4 | 17 | 77 | 102 |
| **HCM7014-EDLR-T-P4S-XL** | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 3 | 3 | 11,6 | 1,4 | 25 | 77 | 102 |
| **VCM7014-CDLR-T-P4S-XL** | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 3 | 3 | 11,6 | 1,4 | 17 | 77 | 102 |
| **VCM7014-EDLR-T-P4S-XL** | 0,56 | 70 | 110 | 20 | 1,1 | 0,6 | 3 | 3 | 11,6 | 1,4 | 25 | 77 | 102 |
| **HCB71916-CDLR-T-P4S** | 0,295 | 80 | 110 | 16 | 1 | 1 | 3,1 | 3,1 | 9,3 | 1,4 | 15 | 86 | 104 |
| **HCB71916-EDLR-T-P4S** | 0,295 | 80 | 110 | 16 | 1 | 1 | 3,1 | 3,1 | 9,3 | 1,4 | 25 | 86 | 104 |
| **HC71916-EDLR-T-P4S** | 0,342 | 80 | 110 | 16 | 1 | 1 | 3,1 | 3,1 | 9,3 | 1,4 | 25 | 86 | 104 |
| **HCM71916-CDLR-T-P4S-XL** | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 17 | 86 | 104 |
| **HCM71916-EDLR-T-P4S-XL** | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 25 | 86 | 104 |
| **VCM71916-CDLR-T-P4S-XL** | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 17 | 86 | 104 |
| **VCM71916-EDLR-T-P4S-XL** | 0,28 | 80 | 110 | 16 | 1 | 0,6 | 2,8 | 2,8 | 9,3 | 1,4 | 25 | 86 | 104 |
| **HCB7016-CDLR-T-P4S** | 0,69 | 80 | 125 | 22 | 1,1 | 1,1 | 4,7 | 4,7 | 12,2 | 2,2 | 15 | 88 | 117 |
| **HCB7016-EDLR-T-P4S** | 0,69 | 80 | 125 | 22 | 1,1 | 1,1 | 4,7 | 4,7 | 12,2 | 2,2 | 25 | 88 | 117 |
| **HC7016-EDLR-T-P4S** | 0,86 | 80 | 125 | 22 | 1,1 | 1,1 | 4,7 | 4,7 | 12,2 | 2,2 | 25 | 88 | 117 |




Mounting dimensions




Mounting dimensions

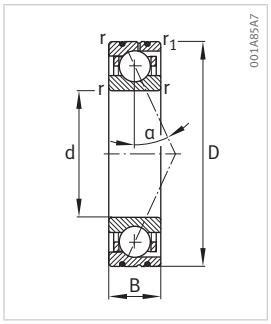
| $r_a$ max. | $r_{a1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 1 | 0,6 | 47500 | 15500 | 28000 | 43000 | 77 | 203 | 424 | 223 | 601 | 1292 | 56 | 81 | 108 |
| 1 | 0,6 | 45500 | 14800 | 26000 | 38000 | 111 | 290 | 602 | 317 | 837 | 1760 | 115 | 160 | 209 |
| 0,6 | 0,3 | 25000 | 16100 | 20000 | 32000 | 55 | 219 | 473 | 161 | 684 | 1562 | 47 | 82 | 116 |
| 0,6 | 0,3 | 23800 | 15300 | 19000 | 28000 | 58 | 309 | 723 | 165 | 904 | 2165 | 102 | 185 | 255 |
| 0,6 | 0,3 | 13000 | 8900 | 24000 | 36000 | 53 | 160 | 321 | 153 | 466 | 946 | 103 | 152 | 196 |
| 0,6 | 0,3 | 19800 | 11100 | 26000 | 38000 | 86 | 226 | 474 | 249 | 673 | 1453 | 57 | 81 | 110 |
| 0,6 | 0,3 | 18900 | 10600 | 26000 | 36000 | 123 | 323 | 671 | 353 | 934 | 1968 | 115 | 161 | 211 |
| 0,6 | 0,3 | 47500 | 15500 | 28000 | 43000 | 77 | 203 | 424 | 223 | 601 | 1292 | 56 | 81 | 108 |
| 0,6 | 0,3 | 45500 | 14800 | 26000 | 38000 | 111 | 290 | 602 | 317 | 837 | 1760 | 115 | 160 | 209 |
| 1 | 0,6 | 41500 | 24300 | 19000 | 30000 | 107 | 385 | 808 | 318 | 1213 | 2688 | 56 | 96 | 135 |
| 1 | 0,6 | 39500 | 23100 | 17000 | 26000 | 137 | 577 | 1276 | 392 | 1694 | 3836 | 131 | 219 | 297 |
| 1 | 0,6 | 18200 | 12200 | 22000 | 34000 | 74 | 223 | 445 | 213 | 647 | 1313 | 118 | 173 | 224 |
| 1 | 0,6 | 20100 | 11600 | 24000 | 36000 | 90 | 237 | 498 | 262 | 707 | 1528 | 59 | 85 | 115 |
| 1 | 0,6 | 19200 | 11100 | 24000 | 34000 | 129 | 339 | 705 | 371 | 981 | 2067 | 120 | 169 | 220 |
| 1 | 0,6 | 48000 | 16300 | 26000 | 40000 | 81 | 213 | 446 | 234 | 631 | 1358 | 59 | 84 | 113 |
| 1 | 0,6 | 46000 | 15500 | 24000 | 36000 | 116 | 304 | 632 | 333 | 879 | 1849 | 120 | 168 | 218 |
| 0,6 | 0,3 | 34500 | 22000 | 19000 | 28000 | 83 | 312 | 665 | 245 | 980 | 2200 | 56 | 95 | 135 |
| 0,6 | 0,3 | 32500 | 20800 | 17000 | 26000 | 98 | 459 | 1040 | 281 | 1343 | 3118 | 126 | 218 | 298 |
| 0,6 | 0,3 | 16800 | 11700 | 22000 | 34000 | 69 | 207 | 414 | 198 | 602 | 1221 | 117 | 173 | 223 |
| 0,6 | 0,3 | 27000 | 15000 | 24000 | 36000 | 116 | 306 | 641 | 337 | 910 | 1965 | 65 | 93 | 125 |
| 0,6 | 0,3 | 26000 | 14300 | 22000 | 32000 | 167 | 437 | 909 | 478 | 1265 | 2665 | 132 | 184 | 241 |
| 0,6 | 0,3 | 65000 | 21000 | 24000 | 38000 | 104 | 274 | 574 | 302 | 812 | 1747 | 64 | 92 | 123 |
| 0,6 | 0,3 | 62000 | 20100 | 24000 | 36000 | 150 | 393 | 816 | 429 | 1133 | 2383 | 131 | 183 | 239 |
| 1 | 0,6 | 50000 | 29500 | 18000 | 28000 | 139 | 487 | 1014 | 414 | 1538 | 3380 | 62 | 105 | 147 |
| 1 | 0,6 | 48000 | 28000 | 16000 | 24000 | 188 | 749 | 1633 | 540 | 2203 | 4915 | 147 | 242 | 326 |
| 1 | 0,6 | 23700 | 15600 | 20000 | 32000 | 98 | 293 | 587 | 280 | 853 | 1731 | 130 | 192 | 248 |
| 1 | 0,6 | 27500 | 15800 | 22000 | 34000 | 122 | 322 | 675 | 355 | 958 | 2069 | 68 | 97 | 131 |
| 1 | 0,6 | 26500 | 15100 | 22000 | 32000 | 176 | 460 | 956 | 503 | 1331 | 2804 | 138 | 193 | 252 |
| 1 | 0,6 | 66000 | 22100 | 24000 | 36000 | 110 | 289 | 605 | 318 | 855 | 1839 | 67 | 96 | 129 |
| 1 | 0,6 | 63000 | 21100 | 22000 | 34000 | 158 | 413 | 858 | 451 | 1192 | 2508 | 137 | 192 | 250 |
| 0,6 | 0,3 | 36000 | 24300 | 17000 | 26000 | 84 | 321 | 686 | 249 | 1004 | 2259 | 59 | 101 | 143 |
| 0,6 | 0,3 | 34000 | 23000 | 15000 | 24000 | 95 | 459 | 1049 | 273 | 1344 | 3137 | 132 | 230 | 315 |
| 0,6 | 0,3 | 19200 | 14000 | 19000 | 30000 | 79 | 236 | 473 | 226 | 686 | 1392 | 130 | 192 | 248 |
| 0,6 | 0,3 | 28000 | 16600 | 22000 | 32000 | 128 | 338 | 709 | 373 | 1006 | 2173 | 71 | 102 | 137 |
| 0,6 | 0,3 | 27000 | 15800 | 20000 | 30000 | 184 | 483 | 1003 | 528 | 1396 | 2943 | 144 | 202 | 263 |
| 0,6 | 0,3 | 67000 | 23200 | 22000 | 34000 | 115 | 303 | 635 | 334 | 898 | 1932 | 70 | 101 | 135 |
| 0,6 | 0,3 | 64000 | 22100 | 22000 | 32000 | 166 | 433 | 900 | 474 | 1251 | 2632 | 143 | 200 | 261 |
| 1 | 0,6 | 65000 | 39000 | 15000 | 24000 | 186 | 640 | 1327 | 554 | 2020 | 4415 | 74 | 123 | 173 |
| 1 | 0,6 | 61000 | 37500 | 14000 | 22000 | 252 | 977 | 2113 | 726 | 2872 | 6354 | 175 | 284 | 383 |
| 1 | 0,6 | 28500 | 19700 | 18000 | 28000 | 117 | 352 | 704 | 336 | 1023 | 2075 | 146 | 215 | 278 |

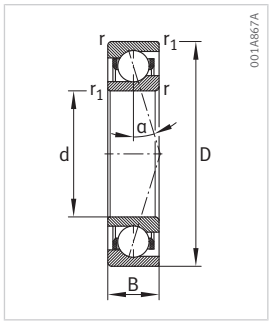
## 2.2.3 Spindle bearings, design DLR

With large, medium or small balls

Ceramic balls

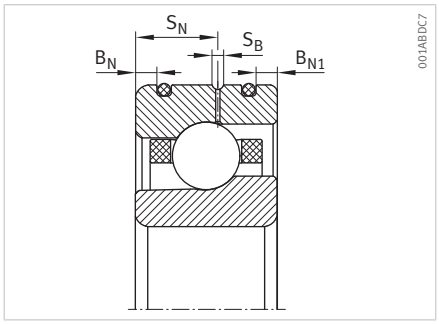
Steel rings or Vacrodur rings

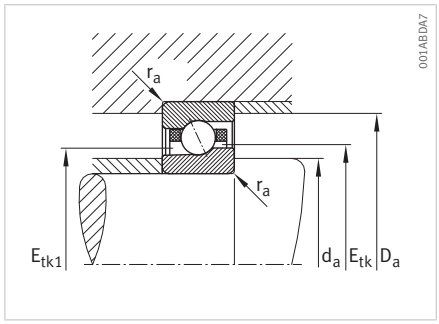


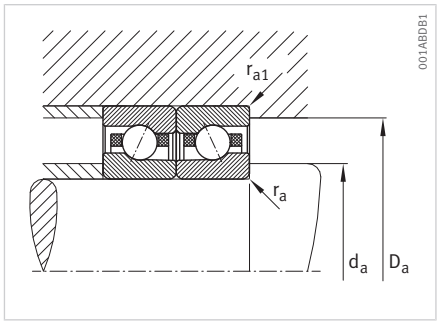

M719, HCM719, VCM719

| Short designation | m | d | D | B | r min | $r_1$ min | $B_N$ | $B_{N1}$ | $S_N$ | $S_B$ | α | $d_a$ h12 | $D_a$ H12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm | mm | mm | ° | mm | mm |
| **HCM7016-CDLR-T-P4S-XL** | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 3,3 | 3,3 | 12,35 | 2,2 | 17 | 88 | 117 |
| **HCM7016-EDLR-T-P4S-XL** | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 3,3 | 3,3 | 12,35 | 2,2 | 25 | 88 | 117 |
| **VCM7016-CDLR-T-P4S-XL** | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 3,3 | 3,3 | 12,35 | 2,2 | 17 | 88 | 117 |
| **VCM7016-EDLR-T-P4S-XL** | 0,81 | 80 | 125 | 22 | 1,1 | 0,6 | 3,3 | 3,3 | 12,35 | 2,2 | 25 | 88 | 117 |
| **HCB71920-CDLR-T-P4S** | 0,64 | 100 | 140 | 20 | 1,1 | 1,1 | 4 | 4 | 12 | 2,2 | 15 | 107 | 133 |
| **HCB71920-EDLR-T-P4S** | 0,64 | 100 | 140 | 20 | 1,1 | 1,1 | 4 | 4 | 12 | 2,2 | 25 | 107 | 133 |
| **HC71920-EDLR-T-P4S** | 0,8 | 100 | 140 | 20 | 1,1 | 1,1 | 4 | 4 | 12 | 2,2 | 25 | 107 | 133 |
| **HCM71920-CDLR-T-P4S-XL** | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 3,4 | 3,4 | 12 | 2,2 | 17 | 107 | 133 |
| **HCM71920-EDLR-T-P4S-XL** | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 3,4 | 3,4 | 12 | 2,2 | 25 | 107 | 133 |
| **VCM71920-CDLR-T-P4S-XL** | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 3,4 | 3,4 | 12 | 2,2 | 17 | 107 | 133 |
| **VCM71920-EDLR-T-P4S-XL** | 0,67 | 100 | 140 | 20 | 1,1 | 0,6 | 3,4 | 3,4 | 12 | 2,2 | 25 | 107 | 133 |
| **HCB7020-CDLR-T-P4S** | 1,01 | 100 | 150 | 24 | 1,5 | 1,5 | 5,5 | 5,5 | 14,5 | 2,2 | 15 | 110 | 141 |
| **HCB7020-EDLR-T-P4S** | 1,01 | 100 | 150 | 24 | 1,5 | 1,5 | 5,5 | 5,5 | 14,5 | 2,2 | 25 | 110 | 141 |
| **HC7020-EDLR-T-P4S** | 1,27 | 100 | 150 | 24 | 1,5 | 1,5 | 5,5 | 5,5 | 14,5 | 2,2 | 25 | 110 | 141 |
| **HCM7020-CDLR-T-P4S-XL** | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 4 | 4 | 14,5 | 2,2 | 17 | 110 | 141 |
| **HCM7020-EDLR-T-P4S-XL** | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 4 | 4 | 14,5 | 2,2 | 25 | 110 | 141 |
| **VCM7020-CDLR-T-P4S-XL** | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 4 | 4 | 14,5 | 2,2 | 17 | 110 | 141 |
| **VCM7020-EDLR-T-P4S-XL** | 1,2 | 100 | 150 | 24 | 1,5 | 1 | 4 | 4 | 14,5 | 2,2 | 25 | 110 | 141 |




Mounting dimensions




Mounting dimensions

| $r_a$ max. | $r_{a1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil | $F_V$ L | $F_V$ M | $F_V$ H | $K_{aE}$ L | $K_{aE}$ M | $K_{aE}$ H | $c_a$ L | $c_a$ M | $c_a$ H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N | N | N | N | N/µm | N/µm | N/µm |
| 1 | 0,6 | 34000 | 21800 | 20000 | 30000 | 169 | 447 | 941 | 495 | 1348 | 2936 | 81 | 118 | 161 |
| 1 | 0,6 | 32500 | 20800 | 19000 | 28000 | 243 | 638 | 1328 | 698 | 1855 | 3929 | 164 | 231 | 304 |
| 1 | 0,6 | 82000 | 30500 | 20000 | 32000 | 152 | 401 | 842 | 443 | 1200 | 2604 | 81 | 117 | 158 |
| 1 | 0,6 | 78000 | 29000 | 20000 | 30000 | 218 | 572 | 1191 | 627 | 1661 | 3509 | 163 | 230 | 301 |
| 0,6 | 0,6 | 60000 | 43000 | 13000 | 20000 | 160 | 572 | 1201 | 473 | 1789 | 3950 | 80 | 135 | 189 |
| 0,6 | 0,6 | 57000 | 40500 | 12000 | 18000 | 204 | 850 | 1876 | 584 | 2489 | 5611 | 187 | 311 | 421 |
| 0,6 | 0,6 | 27000 | 21200 | 15000 | 24000 | 109 | 328 | 656 | 313 | 951 | 1927 | 162 | 239 | 307 |
| 0,6 | 0,6 | 38500 | 24600 | 17000 | 24000 | 190 | 500 | 1049 | 551 | 1489 | 3217 | 89 | 129 | 173 |
| 0,6 | 0,6 | 36500 | 23500 | 16000 | 24000 | 273 | 715 | 1487 | 782 | 2070 | 4362 | 182 | 255 | 333 |
| 0,6 | 0,6 | 92000 | 34500 | 17000 | 26000 | 170 | 448 | 939 | 494 | 1329 | 2860 | 89 | 127 | 170 |
| 0,6 | 0,6 | 88000 | 33000 | 17000 | 24000 | 245 | 642 | 1334 | 702 | 1855 | 3901 | 181 | 253 | 330 |
| 1,5 | 0,6 | 83000 | 55000 | 13000 | 19000 | 241 | 823 | 1703 | 717 | 2587 | 5636 | 89 | 148 | 206 |
| 1,5 | 0,6 | 79000 | 52000 | 11000 | 17000 | 333 | 1266 | 2723 | 957 | 3715 | 8170 | 212 | 343 | 459 |
| 1,5 | 0,6 | 34500 | 26000 | 15000 | 22000 | 144 | 431 | 863 | 412 | 1252 | 2539 | 171 | 253 | 326 |
| 1,5 | 0,6 | 43000 | 31000 | 16000 | 24000 | 240 | 635 | 1336 | 703 | 1915 | 4174 | 106 | 154 | 210 |
| 1,5 | 0,6 | 41000 | 29500 | 16000 | 22000 | 345 | 905 | 1885 | 991 | 2633 | 5578 | 215 | 302 | 397 |
| 1,5 | 0,6 | 103000 | 43000 | 17000 | 24000 | 215 | 569 | 1196 | 629 | 1706 | 3702 | 105 | 152 | 206 |
| 1,5 | 0,6 | 98000 | 41000 | 16000 | 24000 | 310 | 812 | 1691 | 889 | 2358 | 4982 | 213 | 300 | 393 |

# 3 Super precision cylindrical roller bearings

## 3.1 Features

FAG super precision cylindrical roller bearings comprise solid outer rings, solid inner rings with a tapered bore (taper 1:12) and cylindrical roller and cage assemblies with cages made from polyamide, brass or PEEK (polyether ether ketone). The outer ring is separable and can thus be mounted separately from the rest of the bearing package. The inner ring is only separable in the case of series NNU49.

The single and double row bearings are used when very high precision under very high radial load is required. Typical areas of application include machine tools and printing machinery. In these applications, they facilitate bearing arrangements with very high precision, high radial rigidity and very high load carrying capacity. In machine tool building, they provide radial support for the main spindle.

Since variations in length during rotary motion can be compensated between the rollers and the ribless raceway without constraining forces, the cylindrical roller bearings are highly suitable as non-locating bearings. Axial forces are supported by axial bearings, such as double direction axial angular contact ball bearings.

### Cylindrical roller bearings in X-life design with TVP cage

The super precision cylindrical roller bearings N10 and NN30 in the X-life design have a higher load carrying capacity and thus a significantly increased rating life. The newly developed roller-guided plastic cage gives lower friction than the previous standard design with brass cage.

The advantages of the X-life design are:

- lower noise level
- running temperatures up to 12 K lower
- less strain on the lubricant
- longer grease operating life
- limiting speeds up to 35 % higher
- higher basic load ratings

The basic dynamic load ratings C are up to 19 % higher than those of the previous bearing designs and the basic rating life $L_{10}$ is up to 65 % longer than the previous standard.

As a result of the increase in the basic rating life $L_{10}$, this gives a longer operating life of the bearings under the same operating conditions. If the rating life values are maintained, alternatively, higher loads can be applied to the bearing arrangement.

### 3.1.1 Single row super precision cylindrical roller bearings

In single row super precision cylindrical roller bearings of series N10, the rollers are guided on the inner ring and held at a spacing from each other by a cage made from polyamide, brass or PEEK.

59 Single row super precision cylindrical roller bearing



#### High speed cylindrical roller bearings with PEEK cage in X-life design

Single row cylindrical roller bearings of series N10 in X-life design are also available with a PEEK high speed cage that is guided on the outer ring. This high speed cage has a geometry with optimised lubrication and allows up to 20 % higher speeds due to reduced friction. As a result of the optimised cage and ring geometry, the permissible displacement path is increased.

High speed cylindrical roller bearings are also available in a hybrid design (HCN) with rollers made from high performance ceramic. This material gives a significant reduction in the friction and wear in the bearing.

As a result, cylindrical roller bearings of the hybrid design (HCN) achieve the highest permissible speeds of any cylindrical roller bearings. Furthermore, the low coefficient of thermal expansion of the ceramic rollers reduces the increase in preload at higher temperatures.

When these hybrid bearings are used, spindles and machinery achieve considerably longer life and the systems are significantly more viable.

Ceramic rollers also lead to increased rigidity in both static and dynamic terms. This has a positive effect on the quality of the machining results.

Hybrid cylindrical roller bearings are also available with half the number of rollers with suffix H193. Due to the reduction in the number of rollers, the speed can be increased further.

60 High speed cylindrical roller bearings



001ACEF7

### 3.1.2 Double row super precision cylindrical roller bearings

Double row super precision cylindrical roller bearings are available with steel rollers. In bearings of series NN30, the rollers are guided on the inner ring and held at a spacing from each other by a cage made from polyamide or brass. The outer ring is ground cylindrically and is separable.

In bearings of series NNU49, the rollers are guided on the outer ring and held at a spacing from each other by a single-piece cage made from brass. The inner ring is removable. The bearings have a smaller cross-section. As a result, smaller centre distances can be achieved in multi-spindle arrangements.

In addition, diameter ranges not described in the product tables can be supplied by agreement.

61 Double row super precision cylindrical roller bearing



001ACF17

### 3.1.3 Sealing

Super precision cylindrical roller bearings are supplied in an open design.

### 3.1.4 Lubrication

Due to the high surface quality of the raceways and rollers, FAG cylindrical roller bearings are particularly suitable for grease lubrication.

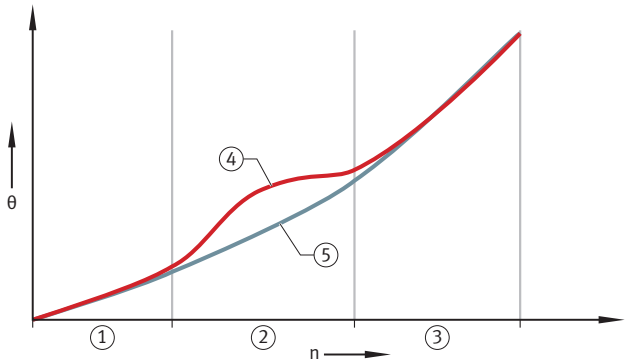
When using pneumatic oil lubrication, they can be lubricated via the end faces. The recommended injection pitch circle diameter ($E_{tk}$) is given in the product tables for the cylindrical roller bearings. In cylindrical roller bearings with a polyamide or brass cage, the recommended injection pitch circle diameter ($E_{tk1}$) lies between the outside diameter of the cage and the outer ring. Lubrication is possible from both sides.

In cylindrical roller bearings with a PEEKcage guided on one side (PVPA1), lubrication is carried out in preference on the open side of the cage between the outside diameter of the cage and the outer ring ($E_{tk1}$). As an alternative, lubrication can be carried out on both sides between the rib on the outer ring and the inside diameter of the cage ($E_{tk2}$).

Cylindrical roller bearings require only very small quantities of oil for lubrication. This applies in particular where cages are guided on the outer ring since the guidance rib in this case prevents all but a small quantity of oil from leaving the bearing. Overlubrication of the bearing can therefore occur, at low and moderate speeds in particular, if lubrication is carried out between the cage and inner ring, as a result of which the operating temperature of the bearing may increase.

If bearings with a PVPA1 cage guided on one side are lubricated on the open side of the cage, excess oil between the outside diameter of the cage and the outer ring is then reliably conveyed out of the bearing, giving a highly uniform temperature behaviour of the bearing.

62 Speed/temperature behaviour of cylindrical roller bearings with cage guided on outer ring with oil lubrication




| | | | |
|---|---|---|---|
| 1 | Low | 2 | Medium |
| 3 | High | 4 | Lubrication between inner ring and cage $E_{tk2}$ |
| 5 | Lubrication on open side of cage $E_{tk1}$ | θ | Temperature |
| n | Speed | | |

Double row bearings with the suffix S have a lubrication groove and lubrication holes in the outer ring for oil lubrication.

Bearings with a modified internal construction (suffix D) do not have a lubrication hole or lubrication groove as standard.

When selecting a lubricant, the operating temperature of the lubricant must be taken into consideration.

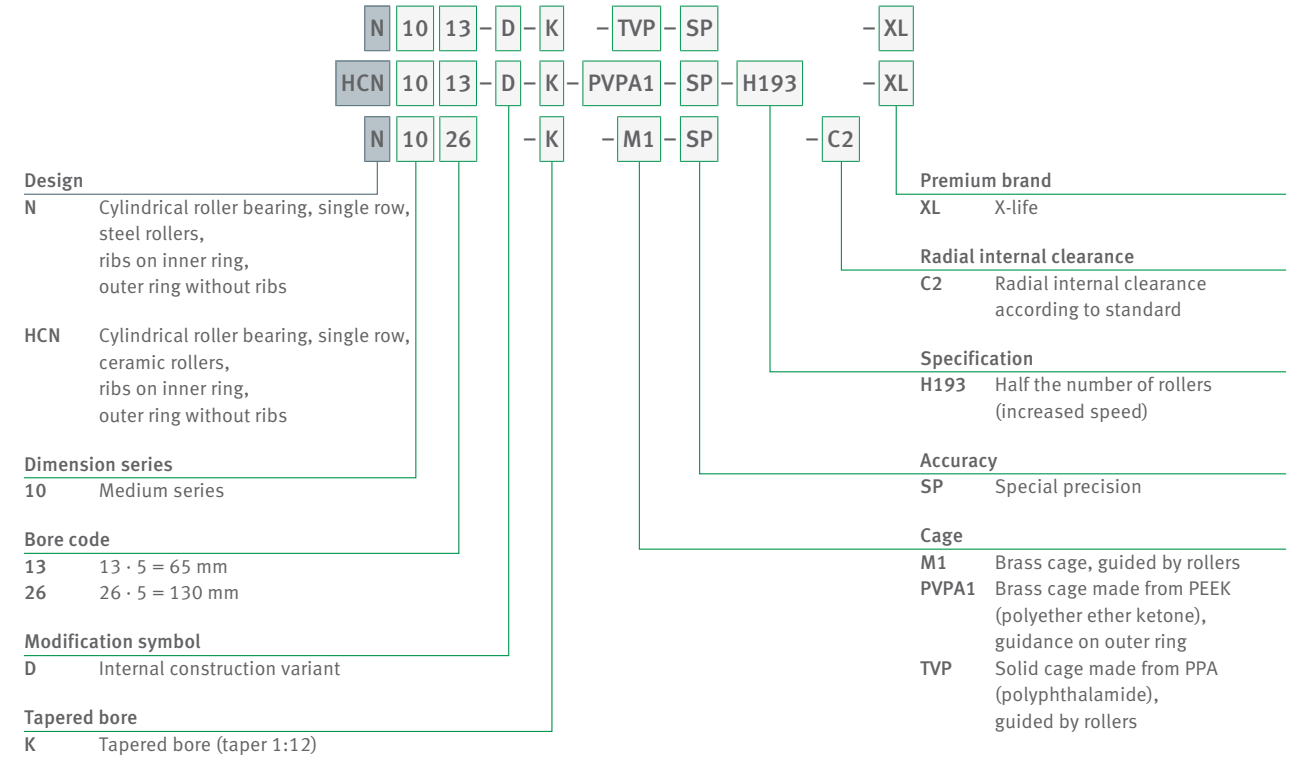
### 3.1.5 Cages

Single row super precision cylindrical roller bearings have solid cages made from polyamide (TVP), brass (M) or PEEK (PVPA1).

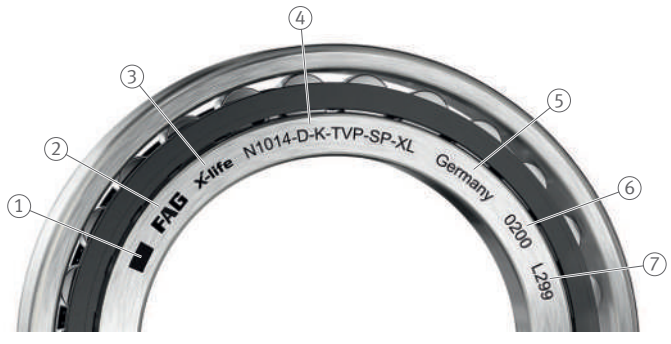
Double row bearings have solid cages made from polyamide (TVP) or brass (M).

### 3.1.6 Designation and marking of bearings

63 Bearing designation, single row cylindrical roller bearings

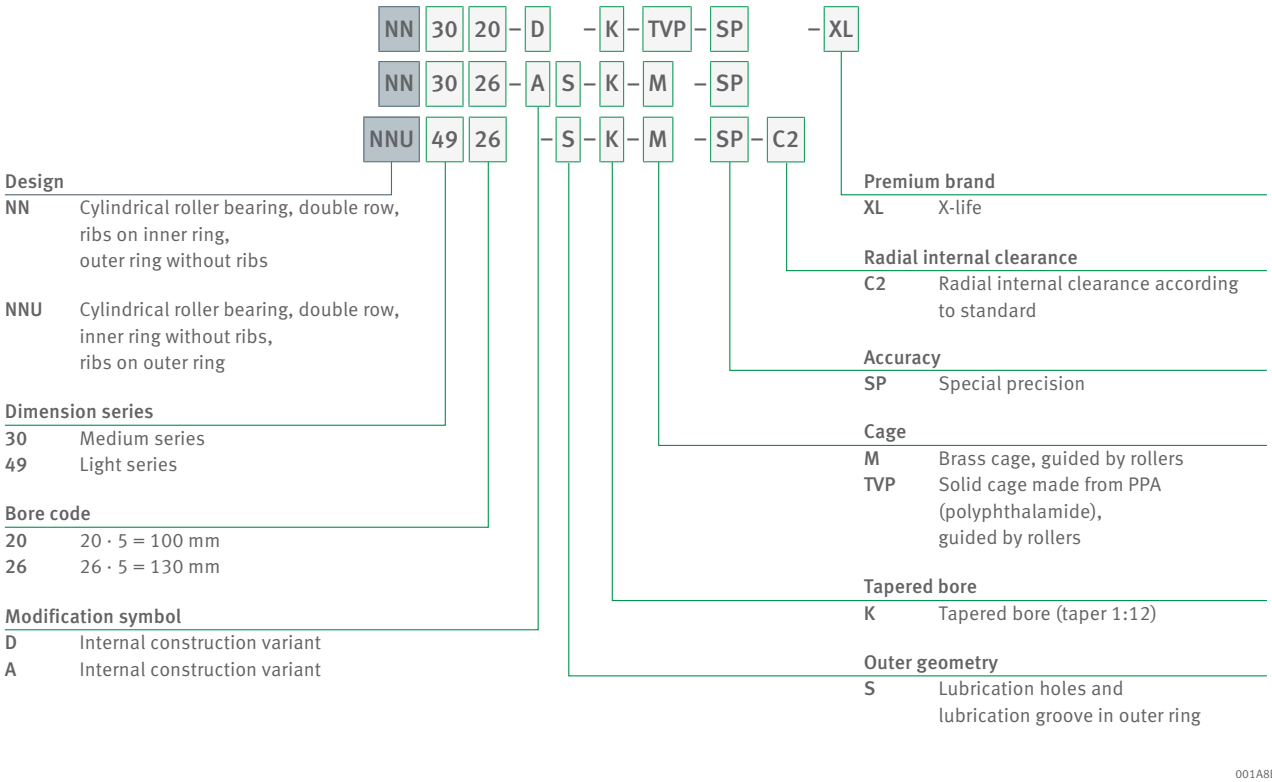



64 Example of marking for single row bearings with TVP cage

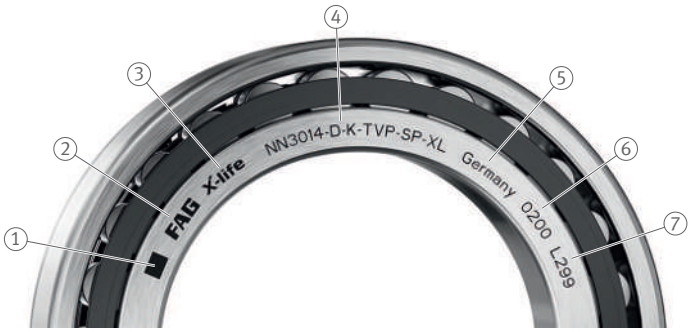



| | | | |
|---|---|---|---|
| 1 | Data matrix code | 2 | Trademark |
| 3 | X-life premium brand | 4 | Short designation |
| 5 | Country of manufacture | 6 | Internal code |
| 7 | Internal code | | |

## 65 Bearing designation, double row cylindrical roller bearings




## 66 Example of marking for double row bearings with TVP cage




| | | | |
|---|---|---|---|
| 1 | Data matrix code | 2 | Trademark |
| 3 | X-life premium brand | 4 | Short designation |
| 5 | Country of manufacture | 6 | Internal code |
| 7 | Internal code | | |

The marking is located on the end faces of the bearing rings.

## 3.2 Product tables

### 3.2.1 Explanations

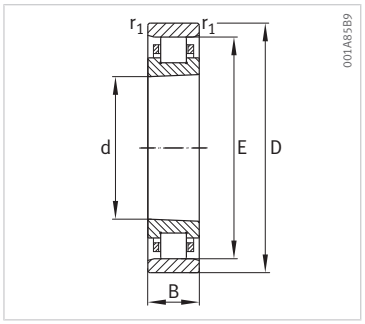
| | | |
|---|---|---|
| B | mm | Width |
| C | mm | Outer ring width |
| $C_{0r}$ | N | Basic static load rating, radial |
| $C_r$ | N | Basic dynamic load rating, radial |
| d | mm | Bore diameter |
| D | mm | Outside diameter |
| $d_a$ | mm | Abutment diameter, shaft shoulder |
| $D_a$ | mm | Abutment diameter, outer ring |
| $D_a$ | mm | Housing shoulder diameter |
| $d_s$ | mm | Lubrication hole diameter |
| E | mm | Raceway diameter of outer ring |
| $E_{tk1}$ | mm | Injection pitch circle diameter 1 |
| $E_{tk2}$ | mm | Injection pitch circle diameter 2 |
| F | mm | Inner ring raceway diameter |
| m | kg | Mass |
| $n_G$ | $min^{-1}$ | Limiting speed |
| $n_G$ grease | $min^{-1}$ | Limiting speed for grease lubrication |
| $n_G$ oil | $min^{-1}$ | Limiting speed for oil lubrication |
| $n_s$ | mm | Lubrication groove width |
| $r_{1\ min}$ | mm | Min. chamfer dimension |
| $r_{a1\ max}$ | mm | Max. undercut radius |
| s | mm | Displacement distance, axial |
| $s_1$ | mm | Displacement distance, axial |
| $s_2$ | mm | Displacement distance, axial |

## 3.2.2 Super precision cylindrical roller bearings N10

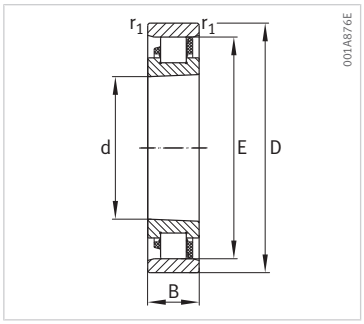
Single row

Steel rollers or ceramic rollers

Cage made from polyamide (TVP), brass (M1) or PEEK (PVPA1)

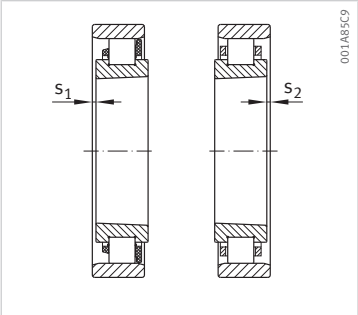



N10

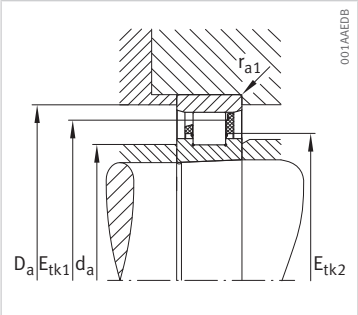



N10-PVPA1-XL

| Short designation | m | d | D | B | $r_1$ min | E | $s_1$ | $s_2$ |
|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm |
| **N1006-D-K-TVP-SP-XL** | 0,12 | 30 | 55 | 13 | 0,6 | 48,5 | 2,8 | 2,8 |
| **N1007-D-K-TVP-SP-XL** | 0,16 | 35 | 62 | 14 | 0,6 | 55 | 2,8 | 2,8 |
| **N1008-D-K-TVP-SP-XL** | 0,2 | 40 | 68 | 15 | 0,6 | 61 | 3,1 | 3,1 |
| **N1008-D-K-PVPA1-SP-XL** | 0,19 | 40 | 68 | 15 | 0,6 | 61 | 1,1 | 3,1 |
| **HCN1008-D-K-PVPA1-SP-XL** | 0,16 | 40 | 68 | 15 | 0,6 | 61 | 1,1 | 3,1 |
| **N1009-D-K-TVP-SP-XL** | 0,24 | 45 | 75 | 16 | 0,6 | 67,5 | 3,1 | 3,1 |
| **N1009-D-K-PVPA1-SP-XL** | 0,24 | 45 | 75 | 16 | 0,6 | 67,5 | 1,2 | 3,1 |
| **N1010-D-K-TVP-SP-XL** | 0,27 | 50 | 80 | 16 | 0,6 | 72,5 | 3,1 | 3,1 |
| **N1010-D-K-PVPA1-SP-XL** | 0,27 | 50 | 80 | 16 | 0,6 | 72,5 | 1,2 | 3,1 |
| **HCN1010-D-K-PVPA1-SP-XL** | 0,23 | 50 | 80 | 16 | 0,6 | 72,5 | 1,2 | 3,1 |
| **N1011-D-K-TVP-SP-XL** | 0,4 | 55 | 90 | 18 | 1 | 81 | 3,4 | 3,4 |
| **N1011-D-K-PVPA1-SP-XL** | 0,4 | 55 | 90 | 18 | 1 | 81 | 1,6 | 3,4 |
| **HCN1011-D-K-PVPA1-SP-XL** | 0,34 | 55 | 90 | 18 | 1 | 81 | 1,6 | 3,4 |
| **N1012-D-K-TVP-SP-XL** | 0,43 | 60 | 95 | 18 | 1 | 86,1 | 3,4 | 3,4 |
| **N1012-D-K-PVPA1-SP-XL** | 0,42 | 60 | 95 | 18 | 1 | 86,1 | 1,6 | 3,4 |
| **HCN1012-D-K-PVPA1-SP-XL** | 0,37 | 60 | 95 | 18 | 1 | 86,1 | 1,6 | 3,4 |
| **N1013-D-K-TVP-SP-XL** | 0,45 | 65 | 100 | 18 | 1 | 91 | 3,4 | 3,4 |
| **N1013-D-K-PVPA1-SP-XL** | 0,45 | 65 | 100 | 18 | 1 | 91 | 1,6 | 3,4 |
| **HCN1013-D-K-PVPA1-SP-XL** | 0,4 | 65 | 100 | 18 | 1 | 91 | 1,6 | 3,4 |
| **N1014-D-K-TVP-SP-XL** | 0,64 | 70 | 110 | 20 | 1 | 100 | 3,8 | 3,8 |
| **N1014-D-K-PVPA1-SP-XL** | 0,61 | 70 | 110 | 20 | 1 | 100 | 1,8 | 3,8 |
| **N1015-D-K-TVP-SP-XL** | 0,67 | 75 | 115 | 20 | 1 | 105 | 3,8 | 3,8 |
| **N1016-D-K-TVP-SP-XL** | 0,9 | 80 | 125 | 22 | 1 | 113 | 4,1 | 4,1 |
| **N1017-D-K-TVP-SP-XL** | 0,95 | 85 | 130 | 22 | 1 | 118 | 4,1 | 4,1 |
| **N1018-D-K-TVP-SP-XL** | 1,23 | 90 | 140 | 24 | 1,1 | 127 | 4,4 | 4,4 |
| **N1018-D-K-PVPA1-SP-XL** | 1,2 | 90 | 140 | 24 | 1,1 | 127 | 2,2 | 4,4 |
| **N1019-D-K-TVP-SP-XL** | 1,29 | 95 | 145 | 24 | 1,1 | 132 | 4,4 | 4,4 |
| **N1020-D-K-TVP-SP-XL** | 1,34 | 100 | 150 | 24 | 1,1 | 137 | 4,4 | 4,4 |
| **N1020-D-K-PVPA1-SP-XL** | 1,29 | 100 | 150 | 24 | 1,1 | 137 | 2,2 | 4,4 |
| **N1021-D-K-TVP-SP-XL** | 1,67 | 105 | 160 | 26 | 1,1 | 146 | 4,5 | 4,5 |
| **N1022-D-K-TVP-SP-XL** | 2,06 | 110 | 170 | 28 | 1,1 | 155 | 4,8 | 4,8 |
| **N1024-D-K-TVP-SP-XL** | 2,22 | 120 | 180 | 28 | 1,1 | 165 | 4,8 | 4,8 |
| **N1026-K-M1-SP** | 3,72 | 130 | 200 | 33 | 1,1 | 182 | 4,2 | 4,2 |
| **N1028-K-M1-SP** | 3,85 | 140 | 210 | 33 | 1,1 | 192 | 4,2 | 4,2 |
| **N1030-K-M1-SP** | 4,81 | 150 | 225 | 35 | 1,5 | 205,5 | 4,4 | 4,4 |
| **N1032-K-M1-SP** | 5,76 | 160 | 240 | 38 | 1,5 | 220 | 4,6 | 4,6 |
| **N1034-K-M1-SP** | 7,77 | 170 | 260 | 42 | 2,1 | 237 | 5 | 5 |
| **N1036-K-M1-SP** | 10,2 | 180 | 280 | 46 | 2,1 | 255 | 5,6 | 5,6 |
| **N1038-K-M1-SP** | 10,6 | 190 | 290 | 46 | 2,1 | 265 | 5,6 | 5,6 |
| **N1040-K-M1-SP** | 13,7 | 200 | 310 | 51 | 2,1 | 281 | 6,4 | 6,4 |




Axial displacement




Mounting dimensions

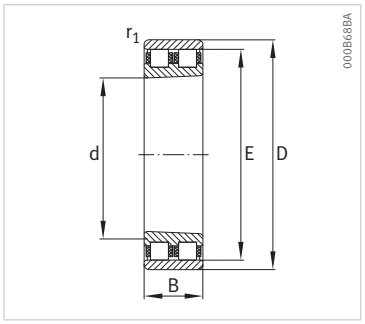
| $d_a$ h12 | $D_a$ H12 | $r_{a1}$ max | $E_{tk1}$ | $E_{tk2}$ | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil |
|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | nom. | nom. | N | N | $min^{-1}$ | $min^{-1}$ |
| 38,5 | 49,5 | 0,6 | 47,5 | – | 17500 | 15600 | 21700 | 25500 |
| 43 | 56 | 0,6 | 53,9 | – | 23600 | 20900 | 18700 | 22000 |
| 49 | 62,1 | 0,6 | 59,8 | – | 27000 | 26000 | 17100 | 20100 |
| 49 | 62,1 | 0,6 | 59,3 | 52,5 | 25000 | 23500 | 27500 | 32000 |
| 49 | 62,1 | 0,6 | 59,3 | 52,5 | 32000 | 27500 | 29000 | 34000 |
| 53,5 | 68,6 | 0,6 | 66,2 | – | 34500 | 32500 | 15200 | 17800 |
| 53,5 | 68,6 | 0,6 | 65,6 | 57,4 | 34500 | 32500 | 24200 | 28500 |
| 58,5 | 73,6 | 0,6 | 71,2 | – | 36500 | 36500 | 14200 | 16800 |
| 58,5 | 73,6 | 0,6 | 70,6 | 62,4 | 36500 | 36500 | 22800 | 27000 |
| 58,5 | 73,6 | 0,6 | 70,6 | 62,4 | 36500 | 34500 | 24900 | 29500 |
| 65 | 82,2 | 1 | 79,3 | – | 48000 | 48500 | 12600 | 14800 |
| 65 | 82,2 | 1 | 78,5 | 69,4 | 44500 | 44000 | 20100 | 23700 |
| 65 | 82,2 | 1 | 78,5 | 69,4 | 44500 | 41500 | 22000 | 26000 |
| 70,1 | 87,3 | 1 | 84,4 | – | 51000 | 53000 | 11900 | 14000 |
| 70,1 | 87,3 | 1 | 83,5 | 74,5 | 47500 | 48500 | 19100 | 22500 |
| 70,1 | 87,3 | 1 | 83,5 | 74,5 | 47500 | 46000 | 20900 | 24600 |
| 75 | 92,2 | 1 | 89,3 | – | 53000 | 58000 | 11400 | 13400 |
| 75 | 92,2 | 1 | 88,5 | 79,4 | 47000 | 49000 | 18200 | 21400 |
| 75 | 92,2 | 1 | 88,5 | 79,4 | 47000 | 46500 | 19900 | 23400 |
| 82 | 101,3 | 1 | 98,2 | – | 66000 | 72000 | 10200 | 12000 |
| 82 | 101,3 | 1 | 97,5 | 86,5 | 58000 | 61000 | 16400 | 19200 |
| 87 | 106,3 | 1 | 103,2 | – | 65000 | 73000 | 9800 | 11500 |
| 93 | 114,4 | 1 | 111,4 | – | 81000 | 91000 | 9000 | 10600 |
| 98 | 119,4 | 1 | 116,3 | – | 80000 | 91000 | 8700 | 10200 |
| 105 | 128,5 | 1 | 124,9 | – | 95000 | 108000 | 8000 | 9400 |
| 105 | 128,5 | 1 | 124 | 111,1 | 89000 | 100000 | 12700 | 15000 |
| 110 | 133,5 | 1 | 129,8 | – | 99000 | 117000 | 7700 | 9100 |
| 115 | 138,5 | 1 | 134,8 | – | 99000 | 118000 | 7500 | 8800 |
| 115 | 138,5 | 1 | 134 | 121,1 | 99000 | 118000 | 11900 | 14100 |
| 120 | 147,5 | 1 | 143,5 | – | 132000 | 154000 | 6800 | 8000 |
| 127 | 156,6 | 1 | 152,4 | – | 153000 | 180000 | 6400 | 7500 |
| 137 | 166,6 | 1 | 162,4 | – | 160000 | 196000 | 6000 | 7100 |
| 148 | 184,1 | 1 | 177,8 | – | 179000 | 250000 | 4800 | 5600 |
| 158 | 194,1 | 1 | 187,8 | – | 183000 | 265000 | 4550 | 5400 |
| 169,5 | 207,8 | 1,5 | 201 | – | 210000 | 310000 | 4250 | 5000 |
| 180 | 222,4 | 1,5 | 215 | – | 245000 | 355000 | 3900 | 4600 |
| 193 | 239,7 | 2,1 | 231,5 | – | 295000 | 435000 | 3600 | 4250 |
| 205 | 257,8 | 2,1 | 248,8 | – | 360000 | 520000 | 3300 | 3850 |
| 215 | 267,8 | 2,1 | 258,8 | – | 370000 | 550000 | 3200 | 3750 |
| 229 | 284,3 | 2,1 | 274,5 | – | 395000 | 600000 | 3000 | 3500 |

## 3.2.3 Super precision cylindrical roller bearings NN30

Double row

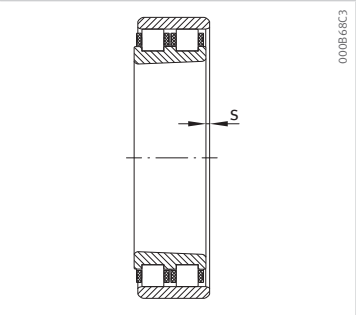
Steel rollers

Cage made from polyamide (TVP)

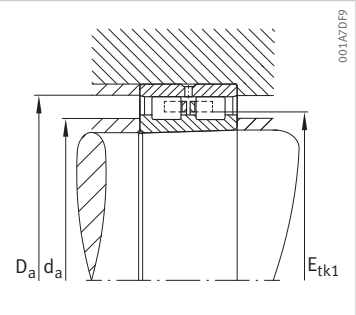



NN30

| Short designation | m | d | D | B | $r_1$ min. | E |
|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm |
| **NN3006-D-K-TVP-SP-XL** | 0,18 | 30 | 55 | 19 | 1 | 48,5 |
| **NN3007-D-K-TVP-SP-XL** | 0,24 | 35 | 62 | 20 | 1 | 55 |
| **NN3008-D-K-TVP-SP-XL** | 0,28 | 40 | 68 | 21 | 1 | 61 |
| **NN3009-D-K-TVP-SP-XL** | 0,36 | 45 | 75 | 23 | 1 | 67,5 |
| **NN3010-D-K-TVP-SP-XL** | 0,39 | 50 | 80 | 23 | 1 | 72,5 |
| **NN3011-D-K-TVP-SP-XL** | 0,59 | 55 | 90 | 26 | 1,1 | 81 |
| **NN3012-D-K-TVP-SP-XL** | 0,63 | 60 | 95 | 26 | 1,1 | 86,1 |
| **NN3013-D-K-TVP-SP-XL** | 0,67 | 65 | 100 | 26 | 1,1 | 91 |
| **NN3014-D-K-TVP-SP-XL** | 0,98 | 70 | 110 | 30 | 1,1 | 100 |
| **NN3015-D-K-TVP-SP-XL** | 1,02 | 75 | 115 | 30 | 1,1 | 105 |
| **NN3016-D-K-TVP-SP-XL** | 1,42 | 80 | 125 | 34 | 1,1 | 113 |
| **NN3017-D-K-TVP-SP-XL** | 1,48 | 85 | 130 | 34 | 1,1 | 118 |
| **NN3018-D-K-TVP-SP-XL** | 1,93 | 90 | 140 | 37 | 1,5 | 127 |
| **NN3019-D-K-TVP-SP-XL** | 2,03 | 95 | 145 | 37 | 1,5 | 132 |
| **NN3020-D-K-TVP-SP-XL** | 2,09 | 100 | 150 | 37 | 1,5 | 137 |
| **NN3021-D-K-TVP-SP-XL** | 2,68 | 105 | 160 | 41 | 2 | 146 |
| **NN3022-D-K-TVP-SP-XL** | 3,41 | 110 | 170 | 45 | 2 | 155 |
| **NN3024-D-K-TVP-SP-XL** | 3,72 | 120 | 180 | 46 | 2 | 165 |




Axial displacement




Mounting dimensions

| s | $d_a$ h12 | $D_a$ H12 | $r_{a1}$ max. | $E_{tk1}$ | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil |
|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | nom. | N | N | $min^{-1}$ | $min^{-1}$ |
| 1,7 | 38,5 | 50 | 1 | 47,5 | 30000 | 31000 | 20600 | 24200 |
| 1,4 | 43 | 56,5 | 1 | 53,9 | 40500 | 41500 | 17800 | 20900 |
| 1,7 | 49 | 62,6 | 1 | 59,8 | 46500 | 52000 | 16200 | 19100 |
| 1,7 | 53,5 | 69,2 | 1 | 66,2 | 59000 | 65000 | 14400 | 16900 |
| 1,7 | 58,5 | 74,2 | 1 | 71,2 | 63000 | 73000 | 13500 | 15900 |
| 1,9 | 65 | 82,9 | 1 | 79,3 | 82000 | 97000 | 11900 | 14100 |
| 1,9 | 70,1 | 88 | 1 | 84,4 | 87000 | 106000 | 11300 | 13300 |
| 1,9 | 75 | 92,9 | 1 | 89,3 | 91000 | 116000 | 10800 | 12700 |
| 2,3 | 82 | 102,3 | 1 | 98,2 | 113000 | 145000 | 9700 | 11400 |
| 2,3 | 87 | 107,3 | 1 | 103,2 | 112000 | 146000 | 9300 | 11000 |
| 2,5 | 93 | 115,6 | 1 | 111,4 | 139000 | 182000 | 8500 | 10000 |
| 2,5 | 98 | 120,6 | 1 | 116,3 | 138000 | 183000 | 8200 | 9700 |
| 2,5 | 105 | 129,8 | 1,5 | 124,9 | 162000 | 216000 | 7600 | 8900 |
| 2,5 | 110 | 134,8 | 1,5 | 129,8 | 170000 | 234000 | 7300 | 8600 |
| 2,5 | 115 | 139,8 | 1,5 | 134,8 | 169000 | 235000 | 7100 | 8300 |
| 2,6 | 120 | 149 | 2 | 143,5 | 226000 | 310000 | 6500 | 7600 |
| 2,9 | 127 | 158,3 | 2 | 152,4 | 260000 | 360000 | 6000 | 7100 |
| 3,1 | 137 | 168,4 | 2 | 162,4 | 275000 | 390000 | 5700 | 6700 |

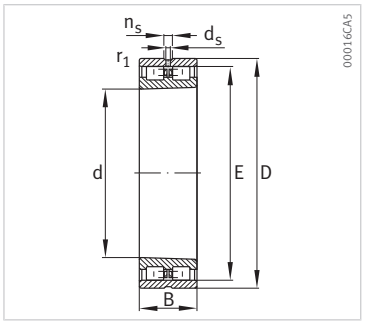
## 3.2.4 Super precision cylindrical roller bearings NN30

Double row

Steel rollers

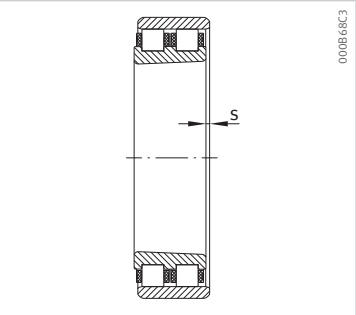
Cage made from brass (M)

Lubrication holes and lubrication groove in the outer ring

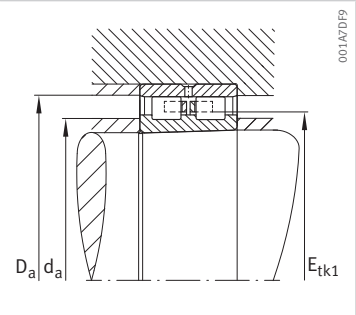



NN30

| Short designation | m | d | D | B | $r_1$ min. | E | $n_s$ | $d_s$ |
|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm |
| **NN3026-AS-K-M-SP** | 5,84 | 130 | 200 | 52 | 2 | 182 | 9,5 | 4,8 |
| **NN3028-AS-K-M-SP** | 6,22 | 140 | 210 | 53 | 2 | 192 | 9,5 | 4,8 |
| **NN3030-AS-K-M-SP** | 7,59 | 150 | 225 | 56 | 2,1 | 206 | 9,5 | 4,8 |
| **NN3032-AS-K-M-SP** | 9,23 | 160 | 240 | 60 | 2,1 | 219 | 9,5 | 4,8 |
| **NN3034-AS-K-M-SP** | 12,5 | 170 | 260 | 67 | 2,1 | 236 | 9,5 | 4,8 |
| **NN3036-AS-K-M-SP** | 16,4 | 180 | 280 | 74 | 2,1 | 255 | 12,2 | 6,3 |
| **NN3038-AS-K-M-SP** | 17,3 | 190 | 290 | 75 | 2,1 | 265 | 12,2 | 6,3 |
| **NN3040-AS-K-M-SP** | 22,2 | 200 | 310 | 82 | 2,1 | 282 | 12,2 | 6,3 |
| **NN3044-AS-K-M-SP** | 29,1 | 220 | 340 | 90 | 3 | 310 | 15 | 8 |
| **NN3048-AS-K-M-SP** | 31,5 | 240 | 360 | 92 | 3 | 330 | 15 | 8 |
| **NN3052-AS-K-M-SP** | 46,2 | 260 | 400 | 104 | 4 | 364 | 15 | 8 |
| **NN3056-AS-K-M-SP** | 49,7 | 280 | 420 | 106 | 4 | 384 | 15 | 8 |
| **NN3060-AS-K-M-SP** | 68,5 | 300 | 460 | 118 | 4 | 418 | 17,7 | 9,5 |
| **NN3064-AS-K-M-SP** | 73,8 | 320 | 480 | 121 | 4 | 438 | 17,7 | 9,5 |
| **NN3068-AS-K-M-SP** | 99,3 | 340 | 520 | 133 | 5 | 473 | 17,7 | 9,5 |
| **NN3072-AS-K-M-SP** | 104 | 360 | 540 | 134 | 5 | 493 | 17,7 | 9,5 |
| **NN3076-AS-K-M-SP** | 110 | 380 | 560 | 135 | 5 | 513 | 17,7 | 9,5 |
| **NN3080-AS-K-M-SP** | 143 | 400 | 600 | 148 | 5 | 549 | 17,7 | 9,5 |
| **NN3084-AS-K-M-SP** | 150 | 420 | 620 | 150 | 5 | 569 | 17,7 | 9,5 |
| **NN3088-AS-K-M-SP** | 172 | 440 | 650 | 157 | 6 | 597 | 23,5 | 12,5 |
| **NN3092-AS-K-M-SP** | 197 | 460 | 680 | 163 | 6 | 624 | 23,5 | 12,5 |
| **NN3096-AS-K-M-SP** | 208 | 480 | 700 | 165 | 6 | 644 | 23,5 | 12,5 |
| **NN30/500-AS-K-M-SP** | 214 | 500 | 720 | 167 | 6 | 664 | 23,5 | 12,5 |




Axial displacement




Mounting dimensions

| s | $d_a$ h12 | $D_a$ H12 | $r_{a1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil |
|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ |
| 3,1 | 150 | 186 | 2 | 295000 | 500000 | 4100 | 4800 |
| 3,4 | 160 | 196 | 2 | 300000 | 520000 | 3900 | 4600 |
| 3,8 | 172 | 210 | 2,1 | 335000 | 590000 | 3650 | 4250 |
| 4,3 | 183 | 224 | 2,1 | 375000 | 670000 | 3400 | 4000 |
| 4,6 | 196 | 241 | 2,1 | 450000 | 800000 | 3100 | 3650 |
| 4,8 | 209 | 260 | 2,1 | 570000 | 1000000 | 2850 | 3300 |
| 4,8 | 219 | 271 | 2,1 | 580000 | 1040000 | 2750 | 3200 |
| 5,7 | 232 | 288 | 2,1 | 660000 | 1190000 | 2550 | 3000 |
| 5,7 | 254 | 317 | 2,5 | 810000 | 1450000 | 2290 | 2700 |
| 6,1 | 274 | 337 | 2,5 | 840000 | 1580000 | 2170 | 2550 |
| 6,6 | 300 | 372 | 3 | 1070000 | 2010000 | 1930 | 2280 |
| 6,9 | 320 | 392 | 3 | 1090000 | 2090000 | 1850 | 2170 |
| 7,5 | 346 | 427 | 3 | 1270000 | 2400000 | 1670 | 1970 |
| 8 | 366 | 447 | 3 | 1330000 | 2600000 | 1610 | 1890 |
| 8,8 | 393 | 483 | 4 | 1640000 | 3250000 | 1470 | 1730 |
| 8,8 | 413 | 503 | 4 | 1670000 | 3350000 | 1420 | 1670 |
| 9,1 | 433 | 523 | 4 | 1700000 | 3500000 | 1370 | 1620 |
| 9,5 | 459 | 560 | 4 | 2150000 | 4450000 | 1260 | 1480 |
| 10 | 479 | 580 | 4 | 2140000 | 4450000 | 1220 | 1440 |
| 10,2 | 501 | 609 | 5 | 2430000 | 5100000 | 1160 | 1360 |
| 10,9 | 524 | 636 | 5 | 2600000 | 5400000 | 1100 | 1300 |
| 11,2 | 544 | 656 | 5 | 2700000 | 5800000 | 1070 | 1260 |
| 11,7 | 564 | 677 | 5 | 2700000 | 5800000 | 1050 | 1230 |

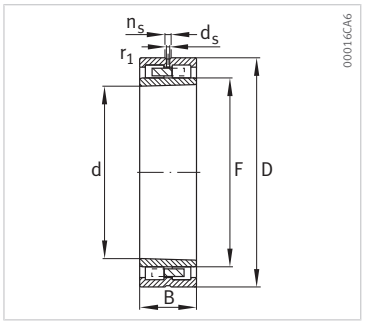
## 3.2.5 Super precision cylindrical roller bearings NNU49

Double row

Steel rollers

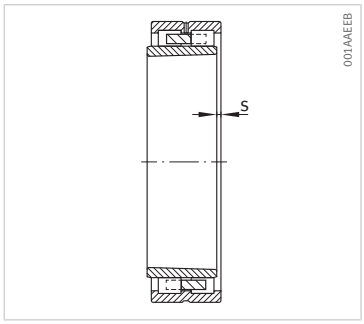
Cage made from brass (M)

Lubrication holes and lubrication groove in the outer ring

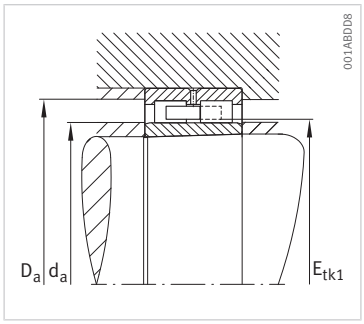



NNU49

| Short designation | m | d | D | B | $r_1$ min. | F | $n_s$ | $d_s$ |
|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm |
| **NNU4920-S-K-M-SP** | 1,88 | 100 | 140 | 40 | 1,1 | 113 | 6,5 | 3,2 |
| **NNU4921-S-K-M-SP** | 1,93 | 105 | 145 | 40 | 1,1 | 118 | 6,5 | 3,2 |
| **NNU4922-S-K-M-SP** | 2,01 | 110 | 150 | 40 | 1,1 | 123 | 6,5 | 3,2 |
| **NNU4924-S-K-M-SP** | 2,78 | 120 | 165 | 45 | 1,1 | 134,5 | 6,5 | 3,2 |
| **NNU4926-S-K-M-SP** | 3,81 | 130 | 180 | 50 | 1,5 | 146 | 6,5 | 3,2 |
| **NNU4928-S-K-M-SP** | 4,04 | 140 | 190 | 50 | 1,5 | 156 | 6,5 | 3,2 |
| **NNU4930-S-K-M-SP** | 6,1 | 150 | 210 | 60 | 2 | 168,5 | 6,5 | 3,2 |
| **NNU4932-S-K-M-SP** | 6,46 | 160 | 220 | 60 | 2 | 178,5 | 6,5 | 3,2 |
| **NNU4934-S-K-M-SP** | 6,9 | 170 | 230 | 60 | 2 | 188,5 | 6,5 | 3,2 |
| **NNU4936-S-K-M-SP** | 9,96 | 180 | 250 | 69 | 2 | 202 | 9,5 | 4,8 |
| **NNU4938-S-K-M-SP** | 10,6 | 190 | 260 | 69 | 2 | 212 | 9,5 | 4,8 |
| **NNU4940-S-K-M-SP** | 14,7 | 200 | 280 | 80 | 2,1 | 225 | 12,2 | 6,3 |
| **NNU4944-S-K-M-SP** | 16,3 | 220 | 300 | 80 | 2,1 | 245 | 12,2 | 6,3 |
| **NNU4948-S-K-M-SP** | 17,1 | 240 | 320 | 80 | 2,1 | 265 | 12,2 | 6,3 |
| **NNU4952-S-K-M-SP** | 30,4 | 260 | 360 | 100 | 2,1 | 292 | 15 | 8 |
| **NNU4956-S-K-M-SP** | 32,5 | 280 | 380 | 100 | 2,1 | 312 | 15 | 8 |
| **NNU4960-S-K-M-SP** | 48,6 | 300 | 420 | 118 | 3 | 339 | 17,7 | 9,5 |
| **NNU4964-S-K-M-SP** | 52,5 | 320 | 440 | 118 | 3 | 359 | 17,7 | 9,5 |
| **NNU4968-S-K-M-SP** | 55,7 | 340 | 460 | 118 | 3 | 379 | 17,7 | 9,5 |
| **NNU4972-S-K-M-SP** | 57,3 | 360 | 480 | 118 | 3 | 399 | 17,7 | 9,5 |
| **NNU4976-S-K-M-SP** | 86,9 | 380 | 520 | 140 | 4 | 426 | 17,7 | 9,5 |
| **NNU4980-S-K-M-SP** | 91 | 400 | 540 | 140 | 4 | 446 | 17,7 | 9,5 |
| **NNU4984-S-K-M-SP** | 94,4 | 420 | 560 | 140 | 4 | 466 | 17,7 | 9,5 |
| **NNU4988-S-K-M-SP** | 130 | 440 | 600 | 160 | 4 | 490 | 17,7 | 9,5 |
| **NNU4992-S-K-M-SP** | 134 | 460 | 620 | 160 | 4 | 510 | 17,7 | 9,5 |
| **NNU4996-S-K-M-SP** | 158 | 480 | 650 | 170 | 5 | 534 | 17,7 | 9,5 |
| **NNU49/500-S-K-M-SP** | 163 | 500 | 670 | 170 | 5 | 554 | 17,7 | 9,5 |




Axial displacement




Mounting dimensions

| s | $d_a$ h12 | $D_a$ H12 | $r_{a1}$ max. | $C_r$ | $C_{0r}$ | $n_G$ grease | $n_G$ oil |
|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ |
| 2 | 112 | 129 | 1 | 128000 | 255000 | 5700 | 6700 |
| 2 | 117 | 134 | 1 | 130000 | 260000 | 5500 | 6500 |
| 2 | 122 | 139 | 1 | 132000 | 270000 | 5400 | 6300 |
| 2,3 | 133,4 | 154,5 | 1 | 175000 | 340000 | 4750 | 5600 |
| 2,7 | 144,7 | 166 | 1,5 | 188000 | 385000 | 4450 | 5300 |
| 2,7 | 155,1 | 176 | 1,5 | 190000 | 400000 | 4250 | 5000 |
| 2,7 | 167,2 | 196,5 | 2 | 330000 | 650000 | 3550 | 4200 |
| 2,7 | 177,2 | 206,5 | 2 | 335000 | 680000 | 3400 | 4000 |
| 2,7 | 187,2 | 216,5 | 2 | 340000 | 700000 | 3300 | 3850 |
| 3,2 | 200,5 | 232 | 2 | 405000 | 860000 | 3000 | 3550 |
| 3,2 | 210,5 | 242 | 2 | 410000 | 880000 | 2900 | 3450 |
| 4,3 | 223 | 259 | 2,1 | 490000 | 1040000 | 2700 | 3200 |
| 4,3 | 243 | 279 | 2,1 | 510000 | 1140000 | 2550 | 3000 |
| 4,3 | 263 | 299 | 2,1 | 530000 | 1210000 | 2400 | 2800 |
| 5,4 | 289,4 | 334 | 2,1 | 750000 | 1690000 | 2070 | 2430 |
| 5,4 | 309,4 | 354 | 2,1 | 770000 | 1790000 | 1970 | 2320 |
| 6,3 | 336 | 389 | 2,5 | 1040000 | 2380000 | 1740 | 2040 |
| 6,3 | 356 | 409 | 2,5 | 1070000 | 2550000 | 1670 | 1960 |
| 6,3 | 376 | 429 | 2,5 | 1100000 | 2650000 | 1600 | 1890 |
| 6,3 | 396 | 449 | 2,5 | 1130000 | 2800000 | 1540 | 1820 |
| 7,2 | 422,6 | 482 | 3 | 1440000 | 3600000 | 1380 | 1620 |
| 7,2 | 442,6 | 502 | 3 | 1490000 | 3800000 | 1330 | 1570 |
| 7,2 | 462,6 | 522 | 3 | 1530000 | 4000000 | 1290 | 1520 |
| 6,8 | 486,8 | 558 | 3 | 2040000 | 5200000 | 1150 | 1360 |
| 6,8 | 506,8 | 578 | 3 | 2110000 | 5500000 | 1120 | 1320 |
| 7,2 | 530,6 | 606 | 4 | 2350000 | 6100000 | 1060 | 1250 |
| 7,2 | 550,6 | 626 | 4 | 2330000 | 6100000 | 1030 | 1220 |

# 4 Axial angular contact ball bearings

## 4.1 Features

Double direction axial angular contact ball bearings of series 2344 are highly rigid, axially preloaded super precision bearings with restricted tolerances to class SP for the bearing arrangements of precision spindles in machine tools.

These bearings without self-retention comprise solid shaft locating washers, a spacer ring, a housing locating washer and ball and cage assemblies with solid cages. The bearing parts are matched to each other and can be fitted separately, but must not be interchanged with parts from bearings of the same size.

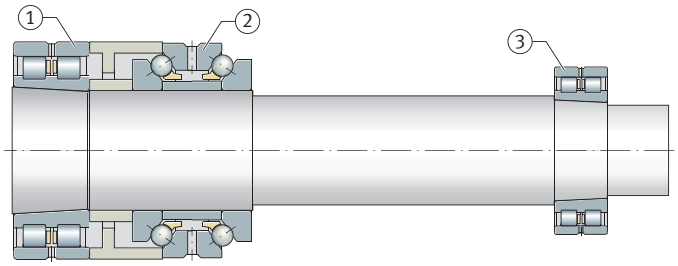
Due to the contact angle of 60°, they can support high axial forces.

In bearing arrangements of main spindles, the axial angular contact ball bearing is combined with a double row cylindrical roller bearing with a tapered bore, which supports the radial forces.

Series 2344 has the same nominal outside diameter as the cylindrical roller bearings NN30. The outside diameter tolerance is designed to give a loose fit when the seats of the axial angular contact ball bearing and the cylindrical roller bearing are machined together.

The bearings are typically combined with double row cylindrical roller bearings.

67 Bearing arrangement with axial angular contact ball bearing 2344




00016B3B

| | | | |
|---|---|---|---|
| 1 | Cylindrical roller bearing NN30 | 2 | Double direction axial angular contact ball bearing 2344 |
| 3 | Cylindrical roller bearing NN30 | | |

### 4.1.1 Sealing

Axial angular contact ball bearings of series 2344 are available without seals.

### 4.1.2 Lubrication

The bearings can be lubricated with oil or grease.

The housing locating washers are designed with a lubrication groove and lubrication holes in the centre. Due to the substantial displacement effect, the bearings require considerably larger quantities of oil than any adjacent cylindrical roller bearings.

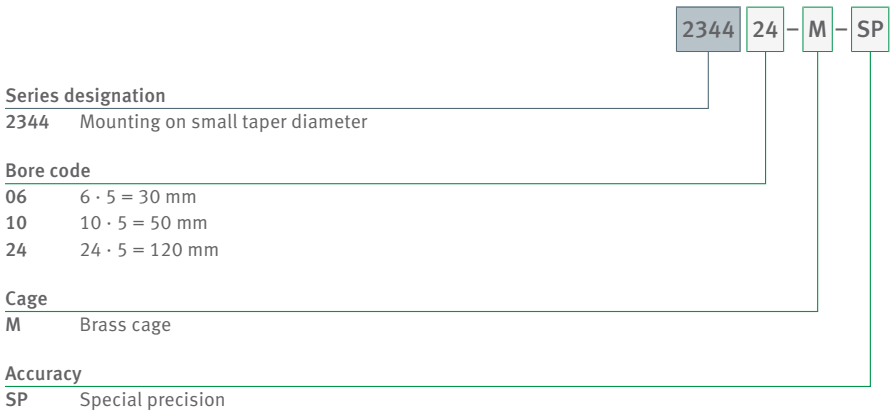
The design must be such that the oil leaving the axial angular contact ball bearings does not enter the adjacent cylindrical roller bearings. When selecting a lubricant, the operating temperature of the lubricant must be taken into consideration.

### 4.1.3 Cages

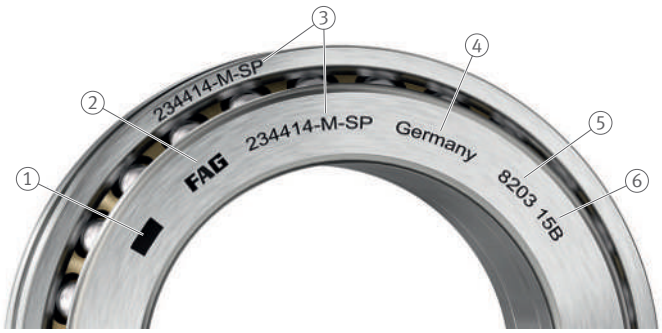
Each row of rolling elements has a ball-guided solid brass cage (suffix M).

### 4.1.4 Designation and marking of bearings

68 Bearing designation




69 Example of marking




| | | | |
|---|---|---|---|
| 1 | Data matrix code | 2 | Trademark |
| 3 | Short designation | 4 | Country of manufacture |
| 5 | Internal code | 6 | Internal code |

The marking is located on the end faces of the bearing rings.

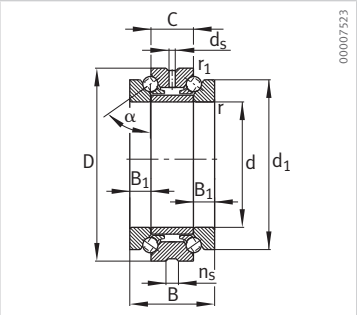
## 4.2 Product tables

### 4.2.1 Explanations

| | | |
|---|---|---|
| B | mm | Width |
| $B_1$ | mm | Shaft washer height |
| C | mm | Outer ring width |
| $C_{0a}$ | N | Basic static load rating, axial |
| $c_a$ | N/µm | Axial rigidity |
| $C_a$ | N | Basic dynamic load rating, axial |
| d | mm | Bore diameter |
| D | mm | Outside diameter |
| $d_1$ | mm | Rib diameter on shaft washer |
| $d_a$ | mm | Abutment diameter, shaft shoulder |
| $D_a$ | mm | Abutment diameter, outer ring |
| $d_s$ | mm | Lubrication hole diameter |
| $F_V$ | N | Preload force |
| $K_{aE}$ | N | Lift-off force |
| m | kg | Mass |
| $n_G$ | $min^{-1}$ | Limiting speed |
| $n_G$ grease | $min^{-1}$ | Limiting speed for grease lubrication |
| $n_G$ oil | $min^{-1}$ | Limiting speed for oil lubrication |
| $n_s$ | mm | Lubrication groove width |
| $r_{1\ min}$ | mm | Min. chamfer dimension |
| $r_{a\ max}$ | mm | Max. undercut radius |
| $r_{a1\ max}$ | mm | Max. undercut radius |
| $r_{min}$ | mm | Min. chamfer dimension |

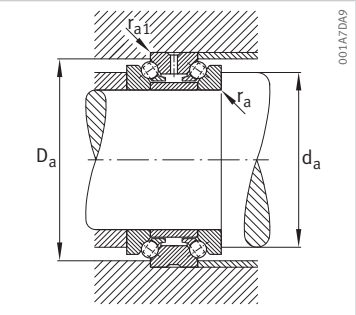
## 4.2.2 Axial angular contact ball bearings

Double direction




2344, α = 60°

| Short designation | m | d | D | B | C | $d_1$ | $B_1$ | r min. | $r_1$ min. | $d_s$ | $n_s$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| **234406-M-SP** | 0,29 | 30 | 55 | 32 | 16 | 47 | 8 | 1 | 0,15 | 3,2 | 4,8 |
| **234407-M-SP** | 0,38 | 35 | 62 | 34 | 17 | 53 | 8,5 | 1 | 0,15 | 3,2 | 4,8 |
| **234408-M-SP** | 0,463 | 40 | 68 | 36 | 18 | 58,5 | 9 | 1 | 0,15 | 3,2 | 4,8 |
| **234409-M-SP** | 0,579 | 45 | 75 | 38 | 19 | 65 | 9,5 | 1 | 0,15 | 3,2 | 4,8 |
| **234410-M-SP** | 0,629 | 50 | 80 | 38 | 19 | 70 | 9,5 | 1 | 0,15 | 3,2 | 4,8 |
| **234411-M-SP** | 0,944 | 55 | 90 | 44 | 22 | 78 | 11 | 1,1 | 0,3 | 3,2 | 6,5 |
| **234412-M-SP** | 1,01 | 60 | 95 | 44 | 22 | 83 | 11 | 1,1 | 0,3 | 3,2 | 6,5 |
| **234413-M-SP** | 1,08 | 65 | 100 | 44 | 22 | 88 | 11 | 1,1 | 0,3 | 3,2 | 6,5 |
| **234414-M-SP** | 1,49 | 70 | 110 | 48 | 24 | 97 | 12 | 1,1 | 0,3 | 3,2 | 6,5 |
| **234415-M-SP** | 1,57 | 75 | 115 | 48 | 24 | 102 | 12 | 1,1 | 0,3 | 3,2 | 6,5 |
| **234416-M-SP** | 2,16 | 80 | 125 | 54 | 27 | 110 | 13,5 | 1,1 | 0,3 | 3,2 | 6,5 |
| **234417-M-SP** | 2,25 | 85 | 130 | 54 | 27 | 115 | 13,5 | 1,1 | 0,3 | 4,8 | 9,5 |
| **234418-M-SP** | 2,92 | 90 | 140 | 60 | 30 | 123 | 15 | 1,5 | 0,3 | 4,8 | 9,5 |
| **234419-M-SP** | 3,04 | 95 | 145 | 60 | 30 | 128 | 15 | 1,5 | 0,3 | 4,8 | 9,5 |
| **234420-M-SP** | 3,17 | 100 | 150 | 60 | 30 | 133 | 15 | 1,5 | 0,3 | 4,8 | 9,5 |
| **234421-M-SP** | 4,07 | 105 | 160 | 66 | 33 | 142 | 16,5 | 2 | 0,6 | 4,8 | 9,5 |
| **234422-M-SP** | 5,19 | 110 | 170 | 72 | 36 | 150 | 18 | 2 | 0,6 | 4,8 | 9,5 |
| **234424-M-SP** | 5,56 | 120 | 180 | 72 | 36 | 160 | 18 | 2 | 0,6 | 4,8 | 9,5 |
| **234426-M-SP** | 8,28 | 130 | 200 | 84 | 42 | 177 | 21 | 2 | 0,6 | 6,3 | 12,2 |
| **234428-M-SP** | 8,78 | 140 | 210 | 84 | 42 | 187 | 21 | 2,1 | 0,6 | 6,3 | 12,2 |
| **234430-M-SP** | 10,8 | 150 | 225 | 90 | 45 | 200 | 22,5 | 2,1 | 0,6 | 8 | 15 |
| **234432-M-SP** | 12,9 | 160 | 240 | 96 | 48 | 212 | 24 | 2,1 | 0,6 | 8 | 15 |
| **234434-M-SP** | 17,7 | 170 | 260 | 108 | 54 | 230 | 27 | 2,1 | 0,6 | 8 | 15 |
| **234436-M-SP** | 23,4 | 180 | 280 | 120 | 60 | 248 | 30 | 2,1 | 0,6 | 8 | 15 |
| **234438-M-SP** | 24,7 | 190 | 290 | 120 | 60 | 258 | 30 | 2,1 | 0,6 | 8 | 15 |
| **234440-M-SP** | 31,5 | 200 | 310 | 132 | 66 | 274 | 33 | 2,1 | 0,6 | 8 | 15 |
| **234444-M-SP** | 41,7 | 220 | 340 | 144 | 72 | 304 | 36 | 3 | 1,1 | 9,5 | 17,7 |
| **234448-M-SP** | 43,8 | 240 | 360 | 144 | 72 | 324 | 36 | 3 | 1,1 | 9,5 | 17,7 |
| **234452-M-SP** | 64,5 | 260 | 400 | 164 | 82 | 354 | 41 | 4 | 1,5 | 9,5 | 17,7 |
| **234456-M-SP** | 69 | 280 | 420 | 164 | 82 | 374 | 41 | 4 | 1,5 | 9,5 | 17,7 |




Mounting dimensions

| $d_a$ h12 | $D_a$ H12 | $r_a$ max. | $r_{a1}$ max. | $C_a$ | $C_{0a}$ | $n_G$ grease | $n_G$ oil | $F_V$ | $K_{aE}$ | $c_a$ |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | N | N | $min^{-1}$ | $min^{-1}$ | N | N | N/µm |
| 40,5 | 50,5 | 1 | 0,15 | 15700 | 38500 | 11000 | 16000 | 108 | 308 | 276 |
| 46,5 | 57 | 1 | 0,15 | 19100 | 46500 | 9500 | 1400 | 134 | 382 | 316 |
| 51,5 | 63,5 | 1 | 0,15 | 22800 | 58000 | 8500 | 12000 | 160 | 456 | 355 |
| 57,5 | 70 | 1 | 0,15 | 25000 | 67000 | 7500 | 10000 | 180 | 514 | 387 |
| 62,5 | 75 | 1 | 0,15 | 27500 | 79000 | 7000 | 9500 | 183 | 522 | 410 |
| 69 | 84,5 | 1,1 | 0,3 | 37500 | 102000 | 6300 | 8500 | 260 | 743 | 458 |
| 74 | 89,5 | 1,1 | 0,3 | 37000 | 102000 | 6000 | 8000 | 255 | 728 | 455 |
| 79 | 94,5 | 1,1 | 0,3 | 39500 | 115000 | 5600 | 7500 | 275 | 785 | 506 |
| 86,5 | 103,5 | 1,1 | 0,3 | 45500 | 133000 | 5300 | 7000 | 325 | 926 | 552 |
| 91,5 | 108,5 | 1,1 | 0,3 | 47500 | 144000 | 5000 | 6700 | 340 | 969 | 589 |
| 98,5 | 117 | 1,1 | 0,3 | 57000 | 173000 | 4500 | 6000 | 400 | 1140 | 640 |
| 103,5 | 122 | 1,1 | 0,3 | 57000 | 179000 | 4500 | 6000 | 400 | 1140 | 655 |
| 110,5 | 130,5 | 1,5 | 0,3 | 66000 | 213000 | 4000 | 5300 | 465 | 1326 | 708 |
| 115,5 | 135,5 | 1,5 | 0,3 | 67000 | 222000 | 4000 | 5300 | 465 | 1326 | 724 |
| 120,5 | 140,5 | 1,5 | 0,3 | 68000 | 229000 | 3800 | 5000 | 685 | 1956 | 843 |
| 128 | 150 | 2 | 0,6 | 74000 | 250000 | 3600 | 4800 | 530 | 1511 | 775 |
| 134,5 | 160 | 2 | 0,6 | 98000 | 325000 | 3400 | 4500 | 695 | 1983 | 854 |
| 144,5 | 170 | 2 | 0,6 | 101000 | 350000 | 3200 | 4300 | 960 | 2736 | 996 |
| 159 | 188 | 2 | 0,6 | 128000 | 440000 | 2800 | 3800 | 900 | 2570 | 978 |
| 169 | 198 | 2,1 | 0,6 | 132000 | 470000 | 2600 | 3600 | 930 | 2649 | 1034 |
| 181 | 211,5 | 2,1 | 0,6 | 143000 | 510000 | 2600 | 3600 | 1320 | 3764 | 1183 |
| 192,5 | 226 | 2,1 | 0,6 | 174000 | 630000 | 2400 | 3400 | 1180 | 3362 | 1149 |
| 206,5 | 245 | 2,1 | 0,6 | 213000 | 770000 | 2200 | 3200 | 1847 | 5270 | 1362 |
| 221 | 263 | 2,1 | 0,6 | 237000 | 880000 | 2000 | 3000 | 1660 | 4733 | 1315 |
| 231 | 273 | 2,1 | 0,6 | 246000 | 940000 | 1900 | 2800 | 2110 | 6021 | 1495 |
| 245 | 291,5 | 2,1 | 0,6 | 280000 | 1060000 | 1800 | 2600 | 2000 | 5704 | 1449 |
| 269 | 318 | 3 | 1 | 340000 | 1330000 | 1600 | 2200 | 2400 | 6848 | 1629 |
| 289 | 338 | 3 | 1 | 350000 | 1420000 | 1500 | 2000 | 2500 | 7134 | 1729 |
| 317,5 | 374,5 | 4 | 1,5 | 395000 | 1630000 | 1400 | 1900 | 2900 | 8257 | 1814 |
| 337,5 | 394,5 | 4 | 1,5 | 415000 | 1830000 | 1300 | 1800 | 3000 | 8542 | 1920 |

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